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IN THIS ISSUE

ARTICLES

Reclamation Welding of Manganese Steel Track Work Units 21
D. B. RICE

The Use of Welded Steel Construction in Remodeling 25
W. S. McFETRIDGE & J. W. HOPKINS

Production Welding of Water-Softener Tanks ... 28
C. J. SAPPINGTON

Steel Tubing Solves Machine Rigidity Problem .. 29
CHESTER MOTT

Oxy-Acetylene Rail Welding 33
ARTHUR HAVENS

Advertisers in this issue 8
What's Here 11
Editorial 19
First All-Welded Passenger Ship 32
The Technical Slant 35
Automatic Resistance Welding 36
Brief Sketches of Welding Jobs 37
New Product Developments 39
News of Industry 42
Construction 42
Trade News 42
Personal 43
Obituary 44
Current Reviews 44
Recent Patents 48
Engineering Data Sheet No. 12 49
Classified 57

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GENERAL ELECTRIC

Reclamation Welding of Manganese Steel Trackwork Units

By
D. B. RICE
Welding Engineer
American Manganese Steel Division,
American Brake Shoe & Foundry Co.
Chicago Heights, Ill.

The extent that manganese steel rails work harden in service is investigated metallurgically. This is also a description of the welding procedure to be used in the reclamation of rail end, frogs crossovers and other units of trackwork.

THE American Railroads have, within the past few years, made remarkable progress in what appear to be opposing directions. They have maintained their leading position as common carriers by higher standards of performance, including greatly increased speeds, luxurious air-conditioned equipment and specialized handling of commodities; and at the same time have made numerous reductions in both passenger and freight rates. Concurrently they have effected economies in operating and maintenance costs while meeting the rigid safety requirements imposed upon them.

Some of these economies are the result of research toward obtaining the best in latest designs or material. Others have come from the reclamation of conventional material and the study of reclamation processes in order to obtain maximum service with a minimum of expense. Manganese steel track-work and welding procedures may be properly classified under the latter heading.

The advent of manganese steel trackwork welding some years ago encouraged a program of research to eliminate such imperfections in new trackwork castings as had made welding difficult. Much has been accomplished since then by changes in design and standards of manufacture, as well as in new developments to increase initial service and insure greater service life.

The progressive manganese steel foundry of today no longer depends exclusively on external inspection of a casting to determine its soundness and ability to withstand the high speed impact of heavy wheel loads, but is guided by well equipped research laboratories employing X-ray equipment capable of exploring the interior of castings five inches in thickness. Its facilities also include laboratories to control the sand used in molding and the elements necessary for correct metal analysis; and to check the tensile strength, impact resistance, ductility and hardness of the castings produced.

Fig. 1—Cross section adjacent to Fig. 2. The intersection lines are the loci of Rockwell hardness determinations shown in Fig. 3.

Fig. 2—Cross section of worn manganese steel frog showing Brinell hardness impressions.

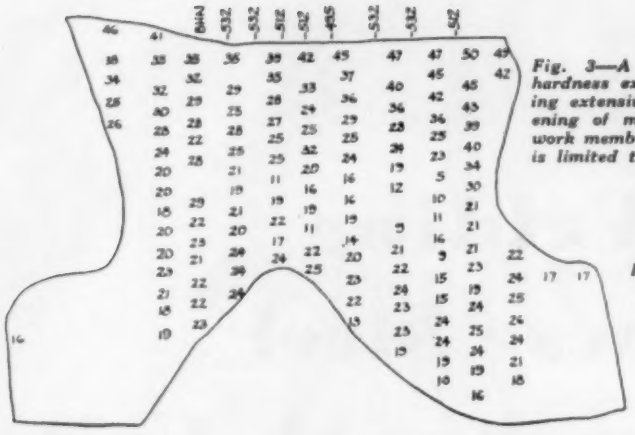

Fig. 3—A Rockwell "C" scale hardness exploration chart showing extensive internal work-hardening of manganese steel trackwork members. Extreme hardness is limited to the wearing surface.

Hardness Equivalents	
Rockwell "C"	Brinell Number
10	185
20	225
30	285
40	375
50	490

Frequently the statement is made that manganese steel trackwork castings manufactured in the distant past stood up better in service than those produced in recent years. Many Maintenance of Way engineers, however, as well as others, acknowledge that the apparent longer life of this type of material in the past merely reflects the fact that loads and speeds were less severe; and that when imperfections existed, they were sufficiently below the running surface to permit a maximum amount of wear and ultimate scrapping of the casting without the knowledge of their existence. However, with increased speeds and wheel loads, any serious defects were apt to become obvious, particularly when economic conditions demanded that each unit deliver the utmost hours of service within limits of safe operation. Weldors engaged in repairing manganese steel castings which were (and still are, in some instances) produced by less modern foundry practice, will still encounter shrink holes, sand and other inclusions, as well as gas porosity, all of which increase the difficulties in obtaining satisfactory welds.

Improved Castings

Cooperative study by the castings manufacturer and the user has resulted in the production of improved castings which, when severely worn in service, can be, more satisfactorily than was formerly the case, reclaimed by welding. Likewise, metallurgical research and study of welding procedures and materials are bearing fruit in improved service life of reclaimed frogs and crossings.

Service conditions subject the steel to a dynamic compression which can be otherwise described as repeated impact or wheel pound. As is generally known, repeated impact work-hardens manganese steel; and, where the metal "flow" under such impact exceeds the ductility of the material, there may follow incipient failure by cracking. Work-hardening can be developed to a point at which all ductility is lost. While no accurate data are available, this limit is believed to be considerably above 500 in the Brinell scale of hardness. Numerous failures in the nature of welds peeling from the parent metal have occurred where weld metal was deposited directly upon such work-hardened surfaces. While visiting trackwork welding crews of various American railroads, we have found interesting the diversity of methods of preparation for and the welding of worn manganese steel frogs and crossings. Some crews weld directly upon work-hardened surfaces, while others remove by grinding any spalled or laminated metal, surface cracks, or other defects. The question has often been asked as to how deep is the "flowed" or work-hardened layer on worn manganese steel trackwork so that a guide may be available for the welding technique and practice during the repair of worn units.

Hardness Tests

Therefore, to learn, if possible, how much metal should be removed from a worn manganese steel frog or crossing before depositing the weld metal, two adjacent sections were prepared from a frog which had been worn down ⅜ in. These sections were cut under water, using a ⅛ in. high speed cut-off wheel, and submitted to our research department for examination. Three specimens for microscopic examination were cut from one sample and Brinell hardness determinations were made at various distances from the worn surface. The other was polished and hot etched on one side, while a Rockwell hardness exploration was made on the opposite side. These specimens are illustrated in Figs. 1 and 2.

A study of the hardness exploration chart, Fig. 3, will show that work-hardening extends to a considerable depth. The intensive hardening indicated by the series of Brinell impressions taken upon the worn surface of the casting are indicative that this extreme condition is limited to the actual wearing surface, especially where false flanges of worn wheels have exerted maximum pressure, and also where new wheels have transferred the maximum load. The upper row of Rockwell hardness readings shows quite plainly the increased hardness developed where the material has deformed or flowed under impact and pressure. This is especially noticeable in the upper left hand corner of the chart where no surface hardening is present, but where the internal metal has been hardened considerably by the extruding action of wheel pressure. Analysis of the chart leads to the conclusion that light wheel loads tend to produce the surface hardening, while heavy loads will cause deeper hardening and more extensive flow.

Work-Hardened Depth

Microscopic examination of samples cut from the first specimen revealed indications of appreciable work-hardening to a depth of at least 0.80 in. These indications are in the form of slip bands in the individual grains of austenite. Where the absence of slip bands denotes total lack of work-hardening, although some carbide precipitation from heat is present along the grain boundaries, one may obtain a good conception of the varying degrees of hardness consequent to cold working, which exist to a considerable depth below the worn surface of trackwork castings. Actually these slip bands indicate the precipitation of sub-microscopic ferrite and manganese-iron carbides as a result of the cold working. Increased hardness and decreased ductility are reasonably in proportion to the density of the slip bands and the carbides so precipitated.

The microscope also revealed the presence of small cracks in the work-hardened surface. These cracks extended to a depth of ¼ in. in some

Fig. 4—The worn pad burned out and ready for grinding prior to welding.

instances and are the result of flow under impact.

The combined effects of both work-hardening and the heat of welding must be considered if good results are to be attained by welding for purposes of reclamation.

Welding Effects

Microscopic study of the effects of the heat of welding on manganese castings shows that where the temperature of the parent metal has been raised high enough to overcome the sluggishness of the transformation of the metastable austenite, considerable precipitation of manganese-iron carbides will take place. This precipitation occurs at the grain boundaries and is the product of both time and temperature. Low thermal conductivity tends to concentrate it in a narrow band adjacent to the line of fusion when the intervals of heat application are not excessively long. It is characterized by an increased hardness, together with decreased ductility. Further study indicates the precipitation present in the manganese steel parent metal ¼ in. below the line of fusion of a nickel-manganese weld. No work-hardening had occurred prior to welding, as indicated by the lack of typical slip band formation. Carbides precipitated by the heat alone are apparent along some boundaries of the austenite grains. If cold-working precedes heating, much of the carbide will be precipitated along the slip planes. The total amount thrown out of solid solution under the combined conditions will be greater; and the increase in hardness and the decrease in ductility will tend to be greater than with either condition alone. An exact evaluation of these two factors is not available at the moment, for such determinations are obtainable only through a long series of careful experiments.

A micrographic study and comparison of specimens will show quite conclusively the effect of high temperatures directly below the weld metal deposit in quantity of carbides precipitated. The combined precipitation by both heat and previous work-hardening has produced a large percentage of carbide in the area, with its proportionate increase in hardness and decrease in ductility.

The conclusions derived from these studies are as follows:

A. Work-hardened metal should be removed from the surface of worn manganese trackwork castings to a depth of at least ¼ in.

B. Optimum results will be obtained by keeping the total heat of welding as low as possible.

Welding Technique

Using these conclusions as a basis, we have endeavored to develop a procedure for preparatory work and a welding technique to minimize inherent disadvantages in manganese steel trackwork welding and so to obtain satisfactory service from reclaimed castings.

There are certain areas on the surface of all manganese steel trackwork castings which are subjected in service to impact and the heaviest concentrated loads. It is known that when weld failures occur, they are invariably within these areas. We feel justified then in suggesting the removal of at least ¼ in. of the worn, cold-worked surface within the limits of the so-termed "impact areas." In many cases, particularly on crossings, this should be increased to the depth of the indicated flow on the wall of the flangeway along the edges of the receiving points. The grinding should be done so as to provide a shelf with a preponderance of horizontal surface to receive the deposited metal, rather than to bevel off at an angle. Manganese steel welds in compression have considerably more impact resistance than those in shear.

A rough test, suitable for field use, may be made to insure the removal of extreme work-hardened material by using an ordinary center punch. Very little impression will be made by such an instrument upon steel with a hardness over 400 Brinell, but when material has been reached which is 250 Brinell or under, the punch indications are appreciable.

Weld Preparation

Where it is necessary to remove large amounts of work-hardened metal, conservation of time dictates the use of oxy-acetylene or arc cutting, Fig. 4. When using the acetylene torch, a relatively high oxygen pressure is preferable to speed up the operation and to reduce heat concentrations. Arc cutting should be controlled as in welding to avoid excessive local heating with its resulting precipitation of carbides to a considerable depth. Where speed is essential, as on work being done in traffic, control of localized heat may be accomplished by making cuts of

Fig. 5—Showing deposited weld metal. Weld partially completed.

short duration and immediately quenching the cut surfaces and surrounding area of the casting with cold water. All torch or arc cut surfaces should be cleaned of oxide and scale, and sufficient metal should be removed by grinding to insure elimination of areas where carbide precipitation is heavy from the heat of cutting. Where excessive heat concentrations are avoided in the burning operation, the removal of ⅛ in. of material from the cut surface should be satisfactory. Sections impossible to grind may be cleaned of scale with an air or hand hammer and chisel.

Electrode Selection

Electrode size for the first two layers of weld metal to be applied over the "impact area" is worthy of consideration. Electrodes of ⅛ in. or $\frac{5}{32}$ in. diameter, using suitable welding circuit amperage, will materially reduce the amount of heat which the parent metal is required to absorb, with corresponding reduction in the area and amount of carbide precipitation. This method assures a minimum of disturbed structure beneath the weld, and the two or more layers as applied with small diameter electrodes constitute a protective pad of nickel-manganese steel weld metal to absorb the higher temperatures created by the larger electrodes used for the major portion of the buildup work. The nickel content of the electrode metal inhibits the precipitation of carbides within the weld metal itself which, therefore, is not affected by the heat of additional layers. Suitable amperages for application of various sized nickel-manganese steel electrodes are shown in Table I.

Table I—Electrode—Amperage Table

Diameter Rod	Bare Rod D.C. Amps.	Coated Rod D.C. Amps.	Coated Rod A.C. Amps.
⅛ in.	80-100	75-90	80-100
$\frac{5}{32}$ in.	90-125	85-110	90-125
$\frac{3}{16}$ in.	110-150	100-130	110-150
¼ in.	135-160	110-140	135-160

Beads deposited by ⅛ in. and $\frac{5}{32}$ in. electrodes should be about ½ in. wide, while $\frac{3}{16}$ in. and ¼ in. electrodes should deposit beads ¾ in. to 1 in. in width. The thickness of the bead should be limited to $\frac{3}{16}$ in. in all cases. Individual beads should be terminated with the consumption of one-half of the usual 18 in. electrode. Bead craters should be filled to the height of the body of the bead before the arc is broken, and each bead should be thoroughly peened, beginning at the filled crater and peening backward toward the starting point. Air or hand hammers may be used for this purpose, but peening must be thorough in order to relieve shrinkage stresses and to provide a denser material that is less susceptible to flow and deformation. It is advisable to plan the bead layout in each layer so that there will be no adjacent craters where accumulated stress may result in the development of cracks or checks, Fig. 5.

In the properly executed weld with planned bead distribution, there will be no excessive stress concentrations or localized overheating of the casting. Parent metal should be cleaned carefully with a wire brush before depositing each bead, because accumulations of oxide, bits of coating and other foreign material will interfere with proper penetration and complete fusion, when electrodes are handled at the specified amperages. Lack of cleanliness often causes weldors to use a greater amperage for the deposition of nickel-manganese steel electrodes than is actually required under better practice for good penetration and fusion.

Fig. 6—The same crossing after having been in service a year.

Finishing of the Welds

Completed welds should be built up higher than the finished dimensions to permit the removal of all irregularities and to provide a smooth, straight surface following the grinding operation. It is desirable to subject completed welds to the peening and leveling action of several trains before grinding them. This practice should be limited, however, for the higher points will quickly work-harden and the localized hardness so initiated may set up stresses which are never completely relieved. Sharp edges where subjected to traffic should be obviated by grinding a radius on all edges that will be followed by the wheel flanges. Where the gage side of the flange is involved, the radius should be about ⅝ in. This will permit a good portion of the anticipated flow to take place before a sharp edge is created with the customary tendency to spalling that follows. Edges followed by the guard side of the flange are ordinarily adequately protected by providing a radius of ⅜ in. In Fig. 6 may be seen a completed weld ground and ready for service.

Welding of manganese steel trackwork during extremely cold weather should be preceded by a slight preheat, limited to 200 F, which will usually prevent the tendency to cracking in both parent and weld metal, found upon the application of welds to manganese castings at 0 F or lower.

Cost Records Important

Reclamation welding of manganese steel trackwork units is in no sense comparable to the predetermined setup of production fabrication. Each frog or crossing must be considered as an individual job with peculiarities of its own. It is often disastrous to hurry with this type of work, because irreparable damage can be done by overheating. Experience, based upon an accurate record of costs and service obtained, should be the deciding factor in determining whether the individual unit should be welded in track, taken out of service for the welding operation, or scrapped as definitely not economical to weld. The cost of such a record is a minor item compared to the saving to be accomplished by its use.

THE END

Fig. 1—In this view may be seen the structural details and method of steel erection.

The Use of Welded Steel Construction in Remodeling

By

W. S. McFETRIDGE and J. W. HOPKINS

Bessmer and Lake Erie R. R. Co. Greenville, Pa.

Larger locomotives require a larger roundhouse. To enlarge a reinforced concrete roundhouse appeared to be quite a problem until welded construction was decided upon. The use of a welded design subsequently saved 13,000 pounds of steel.

In 1911 a 17-stall roundhouse was completed at Greenville, Pa. This building was of reinforced concrete construction throughout including columns, beams, purlins and roof. Being of typical roundhouse design, the 17 stalls were located radially about the center of a turntable used for turning locomotives, with a radius of 89 ft. to the center line of the front columns and of 179 ft. to the rear columns. Each stall was 15 ft. 6¼ in. in width at the front, 31 ft. 2½ in. at the rear and 90 ft. in depth, with a central angle of 10 deg. and one track in each stall.

In the 30 years which had elapsed since the completion of the roundhouse, the locomotives had become larger and larger so that finally the larger locomotives were too long for the stalls. Since the roundhouse was in excellent repair, it was decided that a survey should be made to see what could be done to extend the stalls and thereby enlarge this reinforced concrete structure to accommodate the larger motive power equipment.

It was found that a total of 10 stalls, six at one end of the building and four near the other end could each be extended 27 feet, without interference with the other buildings and adjoining facilities and by making diagonal or skewed ends on the adjoining shorter stalls, the additional room required for the large locomotives could be obtained. In order to provide more efficient lighting, ventilation and headroom for the building as extended it was necessary to provide a higher roof than on the old building, and it was decided to remove a large part of the concrete roof and build the roof higher over stalls not extended, in addition to making the higher roof over the extended stalls.

No radical alterations were required on the concrete building. It was only necessary to remove part of the roof slab and purlins, the monitor, and the curtain walls between rear columns of the original building to permit of the extension and enlargement. All the concrete columns and radial beams between stalls were reused as supports for the new roof and extension. This entailed a minimum of loss on the original structure.

Extension Structure

In comparing the types of construction that could be used, careful consideration was given to the fact that the new work had to satisfactorily join with and form an extension to a reinforced concrete roundhouse, provide for proper lighting and ventilation of the enlarged building, and be of suitable fire resisting construction.

A welded steel structure was considered and decided upon as over-

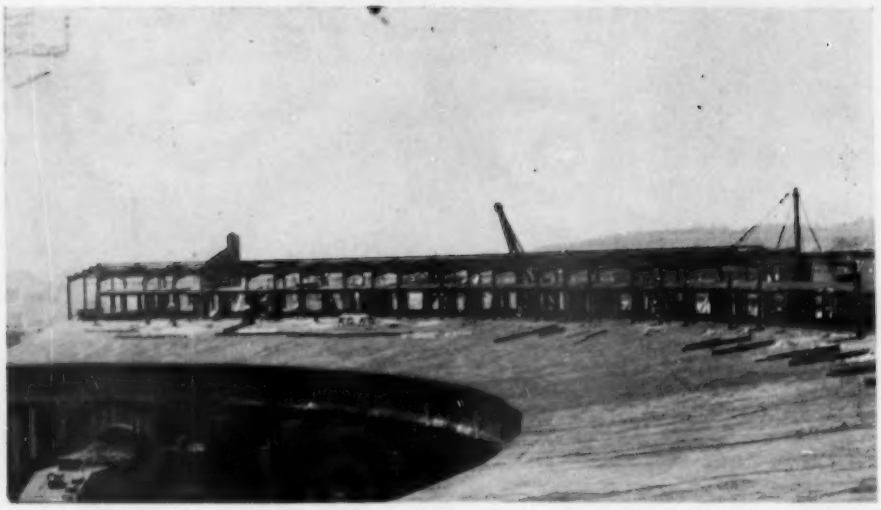

Fig. 2—The placing of steel over the concrete monitor was one of the more difficult operations.

coming many difficulties encountered with other methods, also offering advantages in construction.

A comparatively simple general plan using rolled beams and columns with no built-up members was worked out, where the only bolting required was that necessary for erection purposes and for steel window connections. The use of welded connections simplified both design and erection.

Welded Construction

The flexibility permitted by the use of welding was especially important at the skewed and angular connections and joints occurring in all stalls, and simplified both office and shop work. Instead of framing beams into the column at the rear of the extended stalls, the column which is an 8 in.-24 lb. C.B. section, was capped and a 12 in. beam placed on top, extending across the stall. This beam is horizontal and makes an angle of 85 deg. with the axis of the column. Radial beams 14 in. in depth rested on top of the 12 in. beam. Members were all welded together and the stiffness required at the joint for wind bracing was secured by welding a plate and angle kneebrace to radial beam. No connection angles were needed.

Similar construction was used in framing beams and columns to carry the new and higher monitor roof on the existing building. 6 in. H columns are carried on beams at the front and rear of this section. Base plates and caps were shop welded to the columns with holes punched for erection purposes, and 12 in.-28 lb. beams are carried on the columns, extending radially. These beams are supported at the center of the monitor roof by an 18 in. beam. Beveled plates are used to secure even bearing under beams laid parallel to the slope of the roof.

Purlins are 8 in. channels on the extension and 6 in. channels on the monitor. Stresses parallel to the plans of the roof are carried by sag rods. In erection, the purlins and the bracing were clamped to the supporting beams and welded in place; no reaming, punching or connection angles were required.

All bracing was field welded in place. Bracing with one exception, consists of angles or angles with a plate. Shop work on these members consisted only of cutting ends to required bevels. The use of welded joints made it possible to eliminate connection angles and punching on all bracing which saved steel and shop work.

The beams were set in place, adjusted to correct position, and spot welded to hold. This procedure eliminated working out a complicated detail for bolting.

Shop Welding

All steel was delivered adjacent to the site of the work unfabricated, except that beveled ends were cut on the columns as required at the mill. All shop work was done in a locomotive boiler shop. Shop welding was done with a stationary power driven 800 amp. electric welding machine with outlets at various points in the building. Shop welding included fastening base plates and caps to columns, fastening shelf angles to columns for window members, fastening window mullions together and various other window connecting pieces. It was necessary in welding the mullions, which were made up of 2 angles and a plate, to use the step-back system of applying welds. Following adoption of this method, no difficulty was encountered in keeping the members true to line.

Field Welding

Field welding was done with a 300 amp. gasoline driven welding generator. All welds were made with heavily coated arc welding rod. One experienced weldor and helper did all of the field welding. A cutting torch was kept on the job and members that did not fit were flame cut with a minimum of time and expense. Members which were not bolted for erection purposes were held in contact

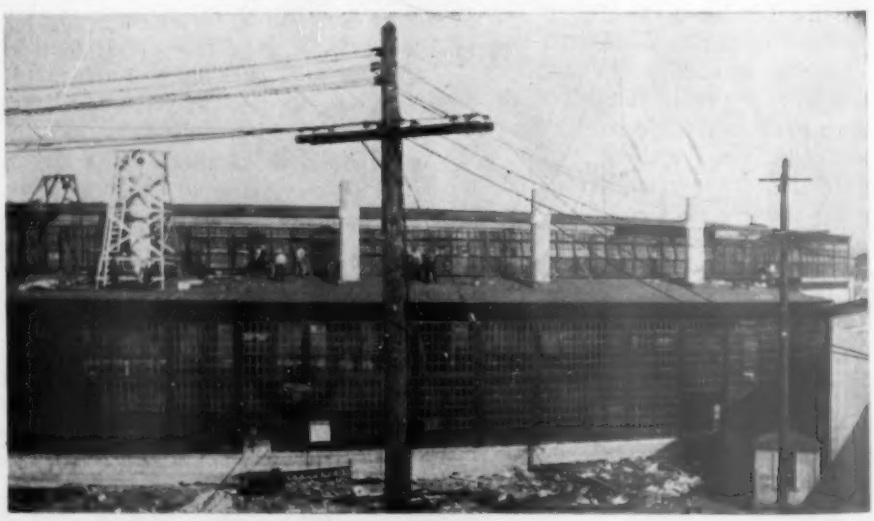

Fig. 3—The remodeling work is nearing completion as the smoke vents are put in place.

with "C" clamps prior to welding. The work was planned as far as possible to make field welding continuous after it had been started. All of the construction work was carried on without putting the building out of service, which required cessation of activity on steel erection on several occasions. When this occurred, the weldor was able to go back and complete welding previously erected pieces and also to help on shop welding.

Advantages of Welding

The use of welded steel construction reduced the work and the cost in the shop, particularly on account of simplification of work at the unusual joints due to the numerous angles in structure and on account of the skewed ends of certain stalls, and also reduced the field work and erection costs. A saving of 13,000 pounds in steel over other methods of construction was secured, as shown in Table I.

The saving in time of erection and field work was made particularly on account of the fact that after main beams were placed, the purlins and other beams could be set in position as desired, and for one or more stalls as convenient, the other work could be carried on over them and the members later welded.

Summary

The estimated reduction in cost, by using welded work is $3,479, which is equivalent to 16½% on the steel framework as compared to riveted construction.

The savings shown would indicate that where this type of construction is suitable, gross savings for steel building construction in general should amount to approximately a like percentage, depending to some extent on type of building and local conditions.

This structure is from its use and location subjected to cinders, smoke and fumes, largely from locomotives, which all tend to cause rust and deterioration, particularly around rivets and connections and it is anticipated that the simple clean cut connections, without rivets or pockets where cinders or gas may collect, and with the excess welding put on to seal joints, will give better service life and reduce maintenance costs as there will be less work required to clean the steel when necessary and the building can be taken care of at a saving in cost for maintenance as well as making a saving in construction.

In the case of the building described, the lack of noise during erection was not important, but would be a major advantage under certain conditions.

Conclusions

The statements herein made apply specifically to the particular problem described, but as consideration will indicate, are applicable in general to all similar problems.

The decision to use welded steel construction was based primarily on the simplification of design and erection, the reduction in shop work so that all work could be handled through our own shop, and all work carried out by regular company employees, but the fact that the cost could also be reduced was not overlooked and was given full consideration. The use of welded steel construction was found to provide an efficient, simple and satisfactory method of obtaining the results desired in this case, as herein indicated. One particular advantage was that there was provided a simple and economical method of extending and enlarging an existing building and it was immaterial that in this case the building extended was of an entirely different type of construction than was the extension. The primary results, as compared with other methods, were for this work simplification and flexibility in design and erection, providing for making necessary adjustments at connections with existing concrete building and a material reduction in cost. This cost is based on actual figures kept on the job and includes bolts, painting, etc. Erection costs include field welding of which there were 2,600 lineal feet of ¼ in., $\frac{5}{16}$ in. and ⅜ in. fillet welds costing an average of 50c per lineal foot, based on the amount actually paid to the weldor.

THE END

Table II—Cost of Steel Work—Welded Joints

337,000 lb. Steel Delivered	@	$ 0.0282	$ 9,503.40
337,000 lb. Steel Shop Work	@	0.0059	1,988.30
337,000 lb. Steel Erected	@	0.0181	6,099.70
Total Cost		$ 0.0522	$17,591.40

TABLE I—Items Eliminated by Use of Welding

Base Plate Connections	156 angles 6 x 4 x ⅜ x 6 in.	959 lbs.
Beam and Column Connection	32 x 26.1 lb. column	835 lbs.
Beam Connection-Rear Ext. Stalls	20 x 6 lb. beam	120 lbs.
Beam Connection at center line monitor	18 x 50 lb. joint	900 lbs.
Diagonal Bracing	16 x 152 lb. stall	2432 lbs.
Knee Bracing	64 ft. 3 x 3 x ⅜ angles	461 lbs.
Knee Bracing	64 angles 3 x 3 x ⅜ x 6 in.	230 lbs.
Knee Bracing	64 plates 6 x ⅜ x 6 in.	245 lbs.
Knee Bracing	64 angles 4 x 3 x ⅜ x 9 in.	434 lbs.
Purlin Clips	800 angles 4 x 3 x ⅜ x 6 in.	3400 lbs.
Purlin Clips	24 angles 3 x 3 x ⅜ x 6 in.	86 lbs.
Purlin Clips	6 angles 3 x 3 x ⅜ x 6 in.	22 lbs.
Beam & Column Connections	104 x 20 lb. column	2080 lbs.
Beam Connection (21" C.B. @ 68")	34 angles 5 x 3½ x ½ x 1 ft. 3 in.	577 lbs.
Miscellaneous		219 lbs.
	Total Amount Steel Saved	13,000 lbs.

*Data and illustrations from a study submitted to the James F. Lincoln Arc Welding Foundation in a recent award program. In its current $200,000 Industrial Progress Award Program, which closes June 1, 1942, the Foundation is offering 458 awards from $100 to $13,700, for reports of advances and improvements made by application of arc welding in design, manufacture, fabrication, construction and maintenance.

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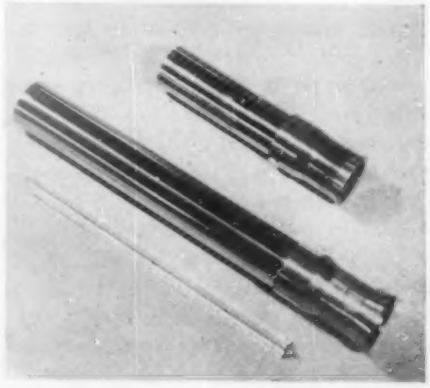

Wall Colmonoy Photo.

A smooth hard-faced pumps sleeves not only last longer but reduce packing wear.

Production Welding of Water-Softener Tanks

By
C. J. SAPPINGTON
The Linde Air Products Co., Indianapolis

A Simple Procedure is Used to make Strong, Leakproof Tanks by Oxy-acetylene Welding and Cutting.

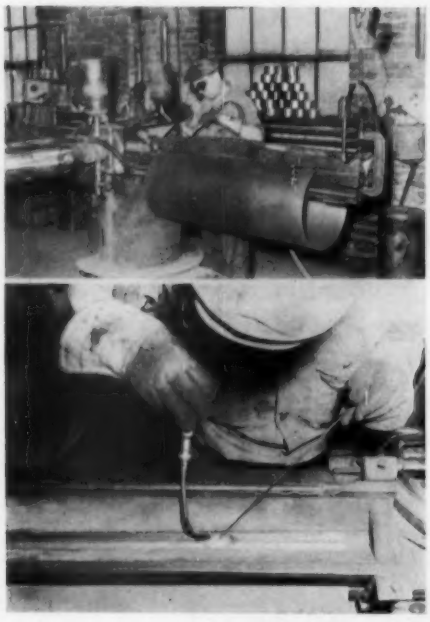

Fig. 1—(Upper) The clamping jig. Fig. 2—(Lower) Heavy holding bars help dissipate the heat.

ORGANIZED welding procedure assisted by the use of welding jigs and oxy-acetylene cutting for auxiliary cutting operations, has been developed by the Puritan Engineering Co., Crawfordsville, Ind., as a standard method for manufacturing their line of softener tanks. These tanks are used for chemically processing water. Each unit includes two cylinders, one of which is 54 in. high by 12 in. in diameter, and the other 42 in. high by 17½ in. in diameter. Material used is a stock steel sheet, sometimes classified as a sheet iron due to its low carbon content, which is particularly suitable for enameling. The cylinders, including baffle plates, heads, and nipples, are of all-welded construction, with oxy-acetylene flame cut openings. The resulting product is strong, leakproof, and attractive in appearance.

The first step in the fabrication of a tank is the roll-forming of sheet metal into cylindrical shape, the sheet having been trimmed to size previously. All of the sheet stock used for the larger tank of the unit is 10 gauge, and for the smaller tank, 16 gauge.

After the forming operation the sheet is placed in a clamping jig, as seen in Fig. 1, which positions it for welding the longitudinal seam. Heavy bars (Fig. 2) hold the sheet securely during the welding operation and help dissipate the heat, thus preventing distortion and buckling. The edges of the sheet are spaced ⅛ in. apart at the beginning of the weld and this distance is increased slightly at the other end to allow for contraction as the weld progresses.

A neutral oxy-acetylene flame and ⅛ in. drawn iron rod are used in making the weld. This rod is selected for its free-flowing qualities and excellent weld ductility. When welding lighter gauge material, used in the smaller companion tank, the operator merely replaces the welding tip with one of smaller size. Oxygen is piped from a cylinder manifold, and acetylene is supplied from a generator.

Fig. 3—Flame cutting plays an important part in many welding operations.

An oxy-acetylene cutting blowpipe provides a ready means for cutting a 5 in. opening in the performed cylinder head which will be welded later to the cylinder body. This operation is an example of the ready "teamwork" of oxy-acetylene welding and cutting on many production jobs. All other openings in the cylinder head and collar are cut by this process.

Into the opening in the cylinder head (shown being cut in Fig. 3) has been welded a collar, which in turn has had a nipple joined to it welding. After preliminary tack-welding, the operator welds the head to the cylinder body, which is supported at a convenient angle on a rolling jig. Following the operation, a bottom, formed of a flanged disk is set into the other end of the cylinder and lap-welded.

Welds in the completed tank are ground (Fig. 4) in preparation for vitreous enameling. In this way a smooth, practically invisible joint is obtained. This procedure is followed in making the smaller tank that completes the unit. There are 187 in. of welds on the large tank and 144 in. on the small. Three welding operators regularly turn out a daily total of six units, or twelve tanks.

A number of completed water-softener units are shown in Fig. 5. All-welded construction produces joints that are strong, leakproof, and maintenance-free for the life of the tank.

Fig. 4—(Upper) Finishing the weld prior to enameling. Fig. 5. (Lower) The finished tank units.

Steel Tube *Solves* Machine Rigidity Problem

Machine design is frequently complicated by the combined demands for both rigidity and light weight construction. A manufacturer of flame cutting machines solved this problem by the use of welding and welded steel tubing.

By
CHESTER MOTT
Chief Engineer
National Cylinder Gas Co.
Chicago

MACHINE flame cutting with one or more mechanically-guided torches has become a well established production process, and a variety of highly developed machines for simple or intricate shaping of steel plate are now procurable.

Flame cutting finds its greatest use in conjunction with welded fabrication and its increased application has paralleled more or less the enormous increase in the adoption of that modern construction method. With this increased use has come the demand for the utmost in machines; machines designed to keep costs down. In other words, users are giving more intensive consideration to maximum economy within the process itself.

Factors that make for economy include quality of cut that holds to a minimum or entirely eliminates subsequent machining operations; convenience of adjustment and control; and a flexibility that permits use of the machine for various types and thicknesses of cut.

Of the several elements involved in "cut quality"—the production of smooth, accurate cuts—accuracy of torch movement is perhaps outstanding. And in this, rigidity of the machine and sensitiveness of carriage movement is basic. Flame cutting is a chemical process which requires precise quantities of oxygen and steel, and variation in steel quantity (torch movement) is as serious as variation of oxygen pressures. Thus not only a constant flow of oxygen but uniform movement of the torch must be maintained as well.

Former Line Redesigned

Various methods have been followed to obtain ample rigidity and sensitive carriage movement, but in the machines recently introduced by the National Cylinder Gas Co., the designer departed from conventional practices. He designed for weld-fabrication utilizing welded steel tubing virtually throughout.

Though markedly improved in structural and other details, the new machines retain the operating principles of previous National flame cutters, namely, a carriage rolling longitudinally upon a drawing table and carrying crossheads and torches having lateral movement upon this carriage.

Tubing Permits All-Steel Design

All structural members of these machines are weld-fabricated from square welded steel tubing. Weld fabrication itself allowed greater freedom of designing in respect to efficient distribution of metal to meet stresses imposed in operation. Then, the use of tube, a material light in weight as well as inherently strong and stiff, resulted in an important advantage, namely, minimum weight of the structure as a whole and particularly of the carriage of the machine. In addition to such advantages as more sensitive carriage movement, less strain on supporting members, including table guides, and lessened power requirements, the light weight permitted constructing the carriage of a single material, steel. And with this, the problem of changes in alinement due to unequal rates of expansion under temperature changes was eliminated.

Simplicity and economy of fabrication with minimum of preparation costs, such as edge planing and straightening, and with minimum of finishing costs, such as machining, has been achieved. Finally, very precise alinement of parts is obtained without the use of welding jigs, for the assembly, the problem of distortion having been taken care of by a system of "wandering" of "skip" welding.

Tubing made from cold rolled strip steel, S.A.E. 1010, medium temper is employed. Commercial tolerances on this material are such that the tubing for all parts can be used just as it comes from the mill. On 1¼ inch square size, for example, the smallest gauge tolerance is plus 0.000 to minus 0.006 inches and size tolerance, plus or minus 0.006 inches. Other toler-

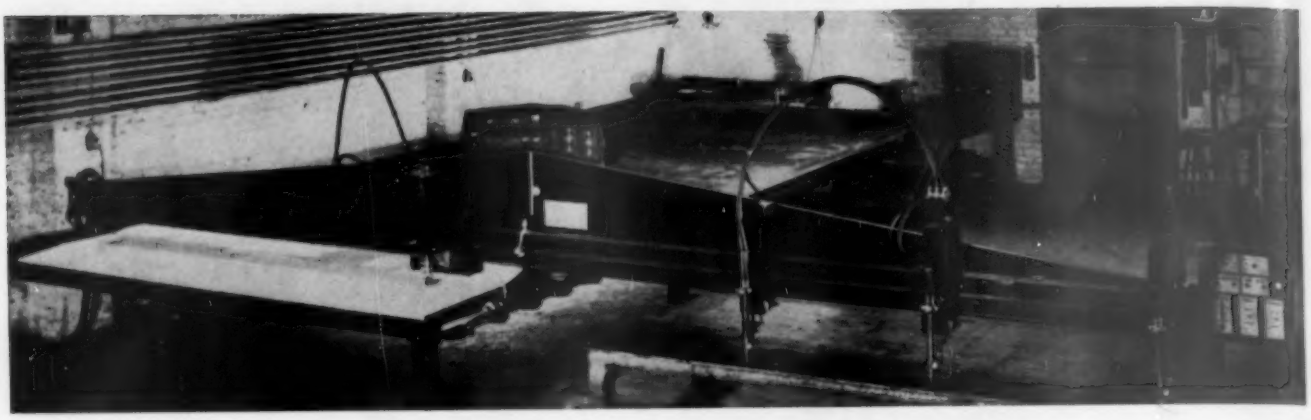

Fig. 1—Square welded steel tubing form the structure of this giant cutting machine.

ances, such as tolerance on side, squareness of sides, and twist are also satisfactory.

How the Tubing Is Used

The main tubular assemblies, table and carriage truss, are shown in Fig. 3.

The table is the foundation of the machine. The one illustrated, for a unit with 10 ft. by 20 ft. cutting range, is made up of three 9-ft. sections and measures 11½ ft. by 27 ft. overall.

Each table section is framed by 4x4x$\frac{3}{16}$ in. steel tubing. Within this frame is a series of joists, one extending the length of the table section and the others across, made of 2x2x⅛ in. tubing. There are four of these cross joists, made up of eight pieces separated by the longitudinal joist. All of these joists are flush with the top of the frame, and in addition to acting as stiffeners they serve to support the table top, which is a light steel plate. Finally, two diagonals made of 2-in. square tubing, one in one piece and the other in two pieces, are used beneath the joists.

The procedure in constructing these table sections has been varied, however, by using one center cross joist made of 4-in. square tubing and two sets of 2-in. diagonals instead of one set as described in the foregoing. Figure 2 illustrates this alternate construction.

Guides Welded in Place

To each side of the table are attached steel guide rails for the carriage. These are of 1½ in. cold rolled bar stock. The one along the right-hand side is set at 45° to the horizontal, as shown in Fig. 4, and rests in V-blocks supported by brackets made of 3-in. heavy channel iron welded to the bottom of the table frame tubing. The V-blocks are held to these brackets by socket head screws and when perfect alinement is secured this guide rail is welded to the V-blocks.

The guide rail at the left-hand side of the table is attached to pads welded along the left-hand table tube, as shown in Fig. 5. This guide rail serves merely to keep the carriage in the level position; the pressure on it is always upward, the weights on the carriage being disposed with this in view. The left-hand guide rail is also at first attached with cap screws and when perfectly alined with the right-hand rail it is permanently fixed by welding.

Table legs are made of 4-in. square tubing. They are capped top and bottom and where table sections join, a long cap is provided at the top to support both table sections. They are attached to the tubular frame by ½" cap screws.

The table top is a single ⅛-in. stretcher leveled cold rolled sheet welded to the table frame in order to form a perfectly flat, smooth surface free from depressions or projections, and from bolts or other fastenings that might loosen.

Table Members "Skip" Welded

In fabricating the table, the four pieces of 4-in. square tubing that make up the frame are assembled on the shop floor, which has been carefully leveled for this work. Trammel marks are made at each corner and then with the assistance of an engineer's transit the frame is made square. One corner is then welded; next the corner diagonally opposite; then the one opposite the first corner, and finally the one diagonally opposite that. Before making the closing weld, diagonal distances are checked against a 1½x2 in. bar marked to exact diagonal length. If the frame is found to be out of square, the difference between the actual and re-

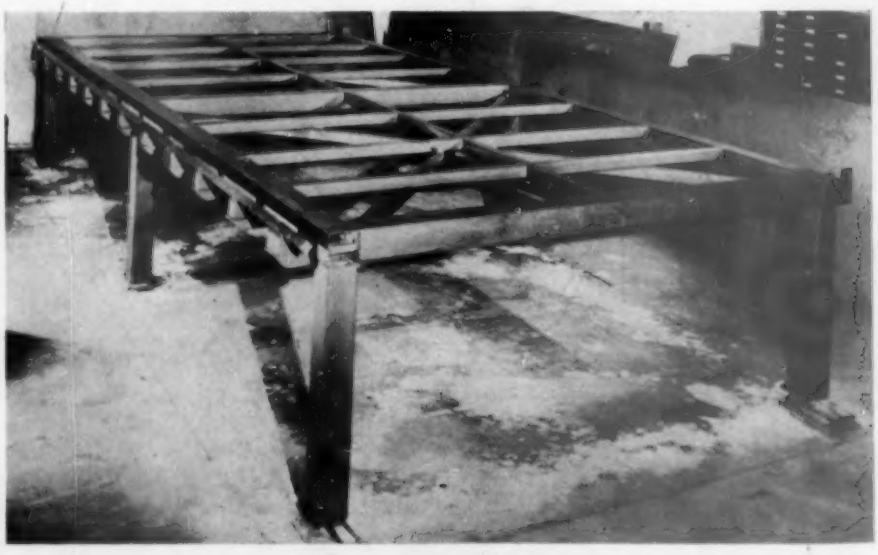

Fig. 2—The table framework is welded without the use of jigs. All members are square steel tubes of standard size.

quired diagonal distance is noted, and half this difference marked on the test bar to work to. With the diagonal test bar held in place as a guide, the fourth joint is closed.

Next the longitudinal joist is put in place and welded, and then the cross joists, in predetermined order. Since the frame rests face down on the floor, the faces of all joists when dropped in place are level with the top of the frame tubes. In welding the joists, the diagonal test bar is used constantly to determine the order of welding. If one joist weld pulls the table frame a little out of square the next joist welded will be one that will pull it back again.

Finally, the diagonal members of the frame are put in place on top of the joists. First the long diagonal is welded to the frame and then the two pieces forming the other diagonal are welded to it and to the frame. In welding these members, too, the squareness of the frame is constantly checked by means of transit and test bar and the order of welding governed accordingly.

Top Stretched on Table Frame

When the frame is completed the top plate is placed over it and tack welded along one edge. Heat is then applied by torch to the central portion to expand the plate a little, and while the plate is in the expanded position intermittent welds are made on the opposite edge. When the plate cools there is just enough pull on it to straighten it out flat and level. Then the welding of all sides is completed. Thus the top plate is actually stretched flat upon the table frame.

Tubing Reduces Carriage Weight

Effective use of welded steel tubing in these new flame cutting machines is most outstanding perhaps in connection with the weld-fabricated carriage.

That rigid, vibrationless construction is especially required of this member is reflected from the fact that a straightness tolerance of torch tip travel, both lateral and longitudinal, is of the order of 0.005 in. And in designing for rigidity, account had to be taken of the fact that the load stresses in the carriage are not constant because the weight of the crossheads, torches and the drive unit is continuously shifting when cutting.

Fig. 3—The table frame and the triangular truss are made of square tubing.

Fig. 4—(Above) The carriage rolls on a guide rail of 1½" square cold rolled steel bar stock.

Fig. 5—(Below) Showing cross section of carriage beam which is built up of two square steel tubes, a formed angle and channel stiffeners.

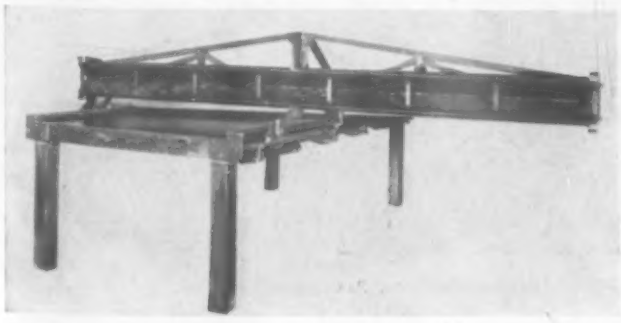

Fig. 6 — Carriage beam assembled on the truss.

From Fig. 3 it will be seen that the carriage is basically a truss construction, and that it is triangular in section both vertical and horizontal, with a large degree to taper from center to the ends. The weight of a 150-pound man on the end of this truss caused a deflection of only .030 inches.

The center-plate section at the apex of this carriage truss (Fig. 2) is made from a solid ⅝-in. steel plate, latticed out by flame cutting and reinforced by welding. It is provided with feet to which are fitted the trucks that carry the ball bearings which roll on the table guideways as shown in Fig. 4. There is another truck assembly at the rear end of the center plate.

The Crosshead Beam

As shown in Fig. 4, each truck under the center plate carries four axles, each of which mounts two ball bearings. The outer races of these ball bearings, which are extremely hard, roll directly on the guide rail. A dust guard projects completely over both right and left-hand guide rails.

Finally, the carriage truss carries a crosshead beam (Figs. 5 and 6) along which the crossheads and the drive unit roll. Through all the crossheads and through the drive unit there runs a tube which is attached to the face of this beam and to which is attached, in turn, a rack. From the close-up view, Fig. 7, it will be seen that the crossheads roll upon the torch beam in exactly the same way that the carriage moves along the front guide rail, except that there is a second truck at the bottom with the ball bearing rollers held upward by springs.

As shown in Fig. 6 this crosshead beam extends clear across the carriage truss. It is clamped securely to the truss at the ends, at the center and at intermediate points, so that the combination of carriage truss and cross-

head beam forms an extremely rigid structure and an adequate guiding and supporting member for all moving and stationary units carried on the carriage.

Truss Construction

In fabricating the carriage truss, which is made of 1¼x1¼x0.120 in. welded steel tubing, welding procedures for assuring squareness are similar to those followed in fabricating the table frame except for the final closing-up welds.

Before the final tie-up welding a short length of bar stock of a size that will just fit inside the tubing is inserted in one of the abutting tubes, with one end protruding. A few holes are then drilled in the same tube to receive the round nose of a screw type C-clamp. The joint is then heated and the squareness of the entire truss ascertained by means of a transit. When made perfectly square, the truss is closed by tightening the C-clamps and then welding around the bar insert and, finally, making plug welds in the drilled holes.

Design of Carriage Beam

A particularly interesting design feature is found in the carriage beam.

Fig. 7—The crossheads roll on the square tube members of the carriage beam.

The cross-section of this component is shown clearly in Fig. 5. The central portion is an angle formed of ⅛-in. steel plate, with 5-in. legs. To the top and bottom of these legs are welded 1¼-in. square x 12 gauge welded steel tubing. The stiffeners are ¾-in. channels spaced equally throughout the length of the beam. The upper tube functions as a guide rail for the torch carriage. Although the straightness tolerances governing the carriage travel is very close, this tubing is purchased without any special specification for straightness other than the standard commercial tolerances. As in the case of the table frame and tubular truss which have been described, welding sequence and transit control are depended upon to accomplish the required straightness in the finished beam. Also, there is no machining or other finishing necessary on the beam surfaces of this tubular rail. The weight of this beam assembly is about five pounds per foot.

Finger Tip Control

It is the combination of delicately balanced and synchronized controls which makes it necessary to provide maximum rigidity in the structural components of the cutting machine and which further makes it desirable to obtain this rigidity with the least weight. The development of a structural design which utilized the inherent structural qualities of the tubular section has accomplished a wholly satisfactory solution of the structural problem.

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First All-Welded Passenger Ship

THE largest and finest ship ever to be launched from Southern Ways recently went into the water at Pascagoula, Miss. It was also the world's first all-welded passenger ship.

Known as the S. S. African Comet, the ship will soon go into the service of the American South African Line and will be one of three ships inaugurating a sixteen and a half day schedule between New York and Capetown, cutting nearly a week from the current schedule. The other two ships, African Meteor and African Comet, are ships of the same design, size and type. These two will be launched this fall.

The African Comet and her sisterships each have a displacement of 17,000 tons, an overall length of 489 feet with a top speed of 19 knots.

The ship will accommodate in addition to a full cargo, one hundred twelve passengers, all the deluxe staterooms being outside, each with a private bath.

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Photo by Ingalls Shipbuilding Corp.

The World's First All-Welded Passenger Ship.

A typical crossing sorely in need of repairs.

Oxy-Acetylene Rail Welding

By
ARTHUR HAVENS

The oxy-acetylene welding of rails provides an inexpensive yet highly satisfactory means of obtaining continuous rail. Welded rails of this type greatly reduce the cost of crossing maintenance.

One of the most difficult problems of the track supervisor is the maintenance of track at highway crossings. This is especially true of crossings where motor traffic is heavy, as there is considerable expense attached to the repair of a busy crossing. It is difficult at times to tie-up traffic and ways and means of avoiding these tie-ups contributes to the maintenance problem. In fact, the whole set up is often so disagreeable that crossings are neglected until they are in a deplorable condition.

Track men have long sought an economical solution to this problem and many ideas have been advanced, tried and discarded. A couple of years ago, a track supervisor, while in conversation with a welding foreman lamented that he must again tear up a very busy crossing; the reason, the rail joints had loosened to a point where the movement of the joints continued to break bond wires almost as fast as they could be affixed. It was the fifth time he had torn out one crossing since Fall and it was not yet Spring.

The welding foreman expressed the opinion that if the trails were continuous through the crossings it might eliminate this trouble. Sensing a nice job, he also suggested that the rails be welded with the oxy-acetylene torch. The track supervisor driven to desperation, was willing to try anything so arrangements were made to rebuild several crossings using continuous welded rail so that there were no rail joints in the highway. The results were excellent. Those crossings with the welded rails required no maintenance through the winter months and are still in perfect condition. Not one failure occurred in the welds or in the welded rail.

This performance is worthy of a few words of explanation, particularly since there is required certain technique that does not enter into the every day routine of weldors.

The rails may be welded in the shop and transported to the job or they may be welded near the place where they are to be used. Naturally, it is simpler to weld them in the shop where grinders and other needed tools are readily available, however, when loading and transporting difficulties are considered, it is nearly as economical to weld the rails on the job.

Welding Preparation

Obviously, a certain amount of care must be exercised during welding and particularly in lining up the rails. They must be perfectly straight and the joints in perfect alignment. Wooden track shims are handy for leveling the joints, i.e., for raising or lowering them to bring them into the correct position.

Ties placed at about 8 ft. intervals make an ideal support for the rails

Lining up the rails in the first step in rail welding.

during the lining up and welding operations. The ties can be placed wherever convenient, alongside of the tracks is a suitable place. Where it is impossible to place the rails alongside the track, they may be set up on the track ties between rails. The major objection to this method is the inconvenience caused the weldor because of the awkward positions he must assume to accomplish his work.

Beveling the Rail Ends

When the rails are suitably aligned, the joints are veed with the cutting torch, the best results are obtained in the following manner: Starting at the outside edge of the flange, this part is veed with a 30 degree cut into the web, the cutting is continued in a slight circular manner so that the "V" is cut through to the back of the flange, the cut is now brought up the web with the same angle to the underside of the ball. This same process is carried out on the other rail making a 60 degree included angle vee that will take in all of one side of the rails. The head or ball of the rail is now veed using the same angle bringing the bottom of this cut well into the V in the web. The remainder of the flange on the other side is now scarfed. This completes the cutting. All slag and oxide are removed from the surfaces near the weld using extreme care not to upset the alignment of the joints.

The welding is started from the side having the major "V." The heat is applied to the center of the rail flange, at the bottom of the web and when this metal is in suitable condition for welding this area is welded. It is well to mention at this point that in the preparation and the initial welding, metal must be deposited at the base of the vee. This is necessary so that all that will be needed when the rail is turned over, upon the completion of welding, will be a washing with the torch to remove the overflow

This is the way the rail ends are scarfed prior to welding.

metal and slag that run through the vee. When the center of the flange is filled with weld metal, the weldor then will bring the balance of the weld flush with the flange of the rail. No reinforcement can be applied at this point because the application of the angle bars require that the weld be absolutely flush. This is not true of the web and a very slight reinforcement may be added. The web is welded in its entirety, then the weldor moves to the other side of the rail, washes off all of the oxide and overflow and welds the rail on this side.

Fitting the Angle Bars

At this point welding is interrupted while track men apply angle bars to the partially welded rail joint. This is imperative for, if the ball of the rail is welded before applying the angle bars the weld metal on the under side of the ball will have a tendency to keep the bars from going into place as they should. When the angle bars are tightened the weldor then completes the welding.

The Finished Weld

The entire weld is made with alloy steel rod designed for this purpose. A slightly carbonizing flame is used throughout the entire operation. For the final ½ in. of welding the acetylene feather is increased to increase the Brinell hardness of the wearing surface of the rail. The finished weld should be a trifle high and then peened level with a hand hammer.

After the weldor has completed his work, the remaining angle or bolts are applied and tightened. When all of the joints are welded and the angle bars in place, the rail is rolled over and the overflow washed off the bottom of the rail flange.

This section is now ready to be placed in the crossing in place of the customary loose jointed rail. When a rail grinder is available, running it across the welded joints makes them very smooth.

Naturally, the welded track is free from the usual click-click as the wheels pass over it. It is reasonable to assume that where there is not continual thumping from the blow of the wheel on the rail joint this track should not require attention for many months at a time.

THE END

The rail welding is completed after the angle bars have been applied.

The Technical Slant

A true University of these days is a collection of books.—Carlyle

Labor Laws

FEDERAL LABOR LAWS. *By Russell L. Greenman and Leslie E. Sanders. Published by National Foremen's Institute, Inc., Deep River, Conn., 1941. Cloth, 5½ x 8 in., 40 pages. Price, $1.50.*

Federal Labor Laws is a timely book in these days of so much confusing and overlapping government legislation. Complicated as it is by rulings and regulations from time to time, federal labor legislation demands some method to make possible complete understanding.

With the advent of thousands of new supervisors, department heads and gang leaders in Industry, one of the greatest problems is that of training the supervisory staff to abide by the federal labor laws. Manufacturers, though usually anxious to abide by these laws, are often the victims of violations of them by supervisors through lack of proper information.

This new edition of a manual especially prepared for supervisors and all those directing workers. It tells them in simple fashion what their status is under these three Acts: the Wagner Act; the Walsh-Healey Act and the Wages and Hours Act. In a condensed manual, is a complete interpretation of the requirements and limitations imposed by the federal laws.

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Aviation

AIR NAVIGATION AND METEOROLOGY, FOURTH EDITION. *By Capt. Richard Duncan. Published by Goodheart-Willcox Co., Inc., Chicago, 1941. Simulated leather, 5 x 8 in., 297 pages. Price $3.00.*

The Fourth Edition of Air Navigation and Meteorology brings up to date the many advances which have taken place in the field of air navigation in the past decade. Much of the original material has been rewritten and the newer developments have been added.

Air Navigation and Meteorology should prove to be an excellent text and reference book not only for the student pilot but also for those wishing to learn more about the problems of air navigation and the weather. It is so written as to be extremely practical as a home study text.

It might be said that the book is presented in three sections though it is not divided sectionally. The first section of nine chapters is devoted to navigation and its related problems. The next section consists of five chapters which discuss aircraft instruments and radio navigation. The seven remaining chapters deal with weather, weather forecasting and maps. Included in this last section is a very complete discussion on ice formation on aircraft.

Mechanics

MECHANISM. *By Stanton E. Winston. Published by American Technical Society, Chicago, 1941. Cloth, 5½x8½ in., 372 pages. Price, $3.50.*

In Mechanism, a companion book to Prof. Winston's Machine Design, it is found that the difficult theories of the modification and transmission of motion are discussed in a new manner.

The mathematical phases of mechanism has been presented in a new light. Each mathematical principle is developed so as to show the reader how each calculation is accomplished. The formula is developed, the conditions at hand are substituted in the formula and the problem is solved.

After each new principle has been explained, illustrative examples are presented and solved as a means of showing the application of the principle. Thus each principle is explained by (a) written explanations, (b) pictures or line drawings and (c) by illustrative problems.

In addition this book contains over 250 practical problems which enhance its value as a reference or home study book in mechanism.

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Welding Instruction

LESSONS IN ARC WELDING, SECOND EDITION. *Published by Lincoln Electric Co., Cleveland, Ohio, 1941. Simulated leather, 6x9 in., 176 pages. Price 50 cents.*

Lessons in Arc Welding is a series of 60 lessons which present fundamental facts of welding, knowledge of which will enable the welder to utilize the process successfully and economically.

Beginning with an introduction giving preliminary instruction to the welder, including suggestions for making and following a definite plan for learning the fundamental principles of arc welding, and for practicing continually, examining welds, criticizing and inviting criticism of work, for wearing proper protective apparel at all times, and assuming proper working positions. Text explanations are graphically supplemented by by-line drawings and photos for ready understanding.

A valuable feature of the book is the set of questions and answers for each lesson enabling the student to check his knowledge. This question and answer section is contained in 25 pages, with 18 pages of questions and 7 of answers. Since the questions are headed by the lesson number and subject matter, they can be of assistance in furnishing the solution to problems. Knowing the subject matter, the student can refer to the index, find the lesson in which it is covered, then turn to the questions on that particular lesson in the back of the book.

Safety

A GOOD MECHANIC SELDOM GETS HURT. *By R. G. Grarnan. Published by American Technical Society, 1941. Paper spiral bound, 5 x 7 in., 104 pages. Price 50 cents.*

In this 104 page pocket size volume there are three characters: "Safety Joe," "Accident Moe" and "Careless Boe," who give many pointers on what to do or not to do in order to be a safe worker.

One of the outstanding features of this book is the manner in which the material is presented. Practically every tool to be found in a machine shop is mentioned in the 76 different discussions included. Each discussion consists of a group of safety precautions applying to a particular hand or machine tool.

Such a grouping arrangement will make it easy for a craftsman to find helpful hints pertaining to a particular tool. Since our present program of defense production is necessitating the training of many workers this book should prove quite helpful in training centers. It is fairly certain that if the warnings of "Safety Joe" are heeded, many accidents will be avoided.

The book is closed with over 80 quiz questions covering pertinent safety points.

» «

Gearing

GEARS AND GEAR CUTTING. *Edited by F. J. Camm. Published by Chemical Publishing Co, Brooklyn, 1941. Cloth, 5½ x 8½ in., 144 pages. Price $2.00.*

In the 12 chapters of Gears and Gear Cutting there has been compiled much concise information on the methods of cutting all types of gears, such as spur gears, warm gears, bevel gears, spiral and screw gears. In Chapter 4 there is found an interesting discussion on gear generation which again discusses all types of gears.

Other chapters discuss epicycle gear trains; methods of mounting, hobs, end-mills and generating cutters; load capacity and efficiency of gears.

For those engaged in gear design, however, the last 23 pages will prove to be the most valuable for they are packed with formulae and other useful information on gears. There is an attempt to confuse the American reader by making reference to "British Standard Notation" with respect to gears. Since the British and American terminology is quite similar, little confusion should result. Here again all types of gears are included.

» «

We should try to succeed by merit, not by favor. He that does well will always have patrons enough.—*Platuus.*

The Technical Slant

Hydraulics

HYDRAULIC MACHINERY. *Edited by E. Molly. Published by Chemical Publishing Co., Brooklyn, 1941. Cloth, 5½ x 8½ in., 96 pages. Price $2.00.*

Hydraulic Machinery is the sixteenth volume in the "Complete Engineer" series. As such it gives a fairly complete survey of up-to-date practice in this phase of heavy manufacture.

In the opening chapter the basic laws which govern all types of hydraulic machinery are discussed. Likewise there is shown the manner in which these laws are applied in practice to the design and construction of a typical machine.

Subsequent chapters are devoted to hydraulic presses and their various applications, such as: forging presses for making of armament and railroad equipment, hydraulic presses for miscellaneous applications and hydraulic shears.

The book is an interesting and informative treatise on that phase of heavy engineering so vital to our basic defense industries.

Machine Tools

JIGS, TOOLS AND FIXTURES, SECOND EDITION. *By Philip Gates. Published by Chemical Publishing Co., Inc., New York, 1941. Cloth, 5½x8½ in., 216 pages. Price $4.00.*

In this enlarged edition of Jigs, Tools and Fixtures the author has endeavored to deal with the subject in a simple manner and at the same time cover the field as thoroughly as possible.

A chapter devoted to materials suitable for jigs, fixtures and tools and for processing purposes has been added in this new edition. There have also been included a number of illustrations picturing the latest practice in jigs and fixtures.

Opening with a chapter on drawing and sketching, the reader is progressively taken into the design of various types of jigs, fixtures and tools, jigs and tool office procedure and standardization. In addition to the many illustrations there are 20 pages of important tables for the designer.

Resistance Welding Data

The Second Edition of the **Resistance Welding Data Book**, devoted to the theory and practice of resistance welding, and generally accepted by the welding industry as a text book on the subject, has just been issued by **P. R. Mallory & Co., Inc.**, Indianapolis, Ind.

There are four sections in the 80 pages of this new edition—

1. Fundamentals of Resistance Welding
2. Materials to be Welded
3. Alloys for Resistance Welding Applications
4. Miscellaneous Tables

Much new material has been added to bring the book up-to-date. Of particular value to welding engineers, production executives, and machine operators. The Data Book is available at no cost when requested on a company letterhead.

» «

Glass, china and reputation are easily cracked—and never well mended.—*Benjamin Franklin.*

Automatic Resistance Welding

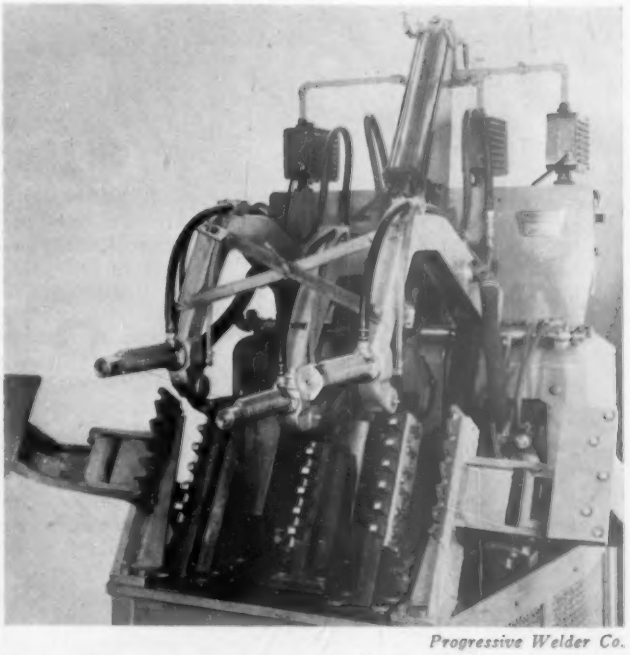
WELDING guns that locate themselves automatically for spot-weld assembling of units built up of a number of parts are features of a welding fixture and gun assembly recently developed for the assembly welding of grilles for a low-priced 1942 model automobile.

The unit is provided with three guns mounted on arms projecting from a slide. The operation required the performing of 17 welds in the assembly of the unit. The fixture was so designed that the welds could be performed in groups of three in five different positions of the welding guns, while in a sixth position, only two of the guns were actuated. This was accomplished by providing the slide carrying the guns with an automatic indexing device.

To assemble the grille, it is necessary only to locate the parts in the fixture over the fixed electrodes, clamp them with the two clamps provided at left and right of the fixture, and press a button.

Once the welding machine is started all of the operations are automatic. The slide moves down to the first position, the points of the guns move in against the work, and the weld cycle is started. The points then move out, and the slide carries the guns to the next welding position. The same cycle is gone through, and the slide moves the guns to a third position. After all welds have been completed, the slide moves the guns to the starting position, and stops, permitting the removal of the assembled grilles and inserting a new set of parts for assembly welding.

With two such welding fixtures it is possible for one to be loaded while the other is going through its assembly welding cycle. The guns are of standard hydraulic design, while the contacts are of the stationary roller type.



This welder will automatically weld 17 spots by moving the electrodes to six different positions.

Progressive Welder Co.

Brief Sketches of Welding Jobs

The use of welding in railroad car repair reduces the time the cars are in the shop.

A G-E Photo.

R. R. Car Repair

Fifteen portable 300-ampere direct-current arc welders are being kept busy in the construction and repair of all-steel coal cars of 50-ton capacity at the Reading Company Shops, Reading, Pa. The Reading is now building 1500 of these cars for its own use, assembling 32 at a time in its shop, and completing 8 cars a day.

Arc welding is now used exclusively by the Reading in the fabrication of under-frame, bolster, and other assemblies.

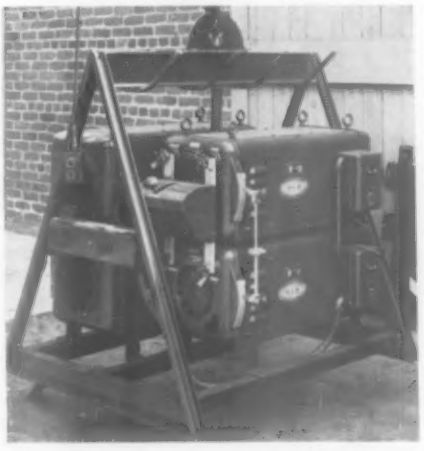
Prior to the recent application of arc welding, riveting was used in the construction of the cars. It was found, however, that reduced costs were obtainable through the use of welding, the elimination of rivet heating resulting in tremendous savings.

A repair program involving 2000 cars, on which electric welding is done in lieu of riveting, is also in progress.

» «

Shipyard welding often makes it necessary to move the welding machines to different locations. The moving of a number of welders is quite costly in that the usual practice is to move one machine at a time. In this case the moving of several welders would not only tie-up a crane for a longer period but delay the welding operators in their work.

To eliminate these crane and weldor delays, the LeMaster-Conzett Co., Los Angeles welding distributors, have designed a stand which will mount four welding machines. This stand, which is of all-welded construction using light structural shapes, has been designed with a lifting eye and hangers for electrode cables. By using such a stand it is possible to move four welders in the time previously required to move one. The entire unit, stand with welders, can be handled with a one-ton chain block. This speeds up work considerably.



Four welders can be handled by a crane, at one time, with this method of mounting.

Broken Casting Replaced

When an end piece, a casting, on a large roll used by Williams Bros Boiler & Manufacturing Co., Minneapolis, for rolling out large sheets used in construction of boilers and tanks was broken, arc welding was used to fabricate a new end piece.

Fig. 1 shows the broken casting, (note large sand hole which probably caused break), and Fig. 2 the welded replacement designed by Mr. Tom Warmington, plant superintendent.

This welded part is now in service and, according to the company, is permitting operation of the roll at higher capacity than was formerly possible. The main plate, in vertical position in the welded part, is 3½ inches thick and the height of the complete piece is 34 inches with a base 4 feet 1 inch wide.

It is interesting to note that this welded replacement, which improved the operating capacity of an important piece of equipment, was fabricated directly from material taken from stock and made up in the company's own shop.

» «

Hoisting Drum Guard

By C. C. Lynde

By welding paired ears at the lower corners of a heavy piece of steel plate, cut to fit the opening in a hoisting drum housing, and by welding brackets at the upper corners, a guard was made to protect the wire line on the drum from accidental injury from tools flying into the aperture. In addition, throwing of grease from the rapidly rotating drum was reduced, and injury resulting from a workman passing too close to the line and being snagged by a "wicker" was eliminated.

The shield straddles the usual housing at the base of the line opening, and is held in place by bolts through the ends of the extended upper brackets. It may be removed simply by loosening a pair of bolts, and as easily replaced after working on the line.

A hoist driven guard of welded design will afford the worker adequate protection.

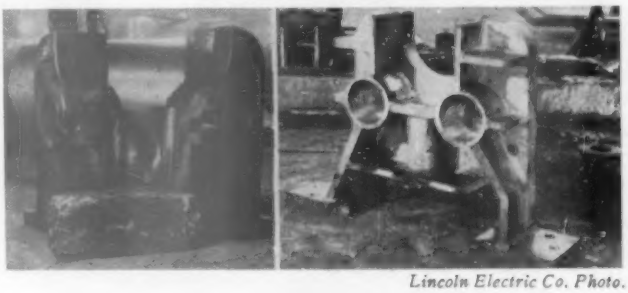
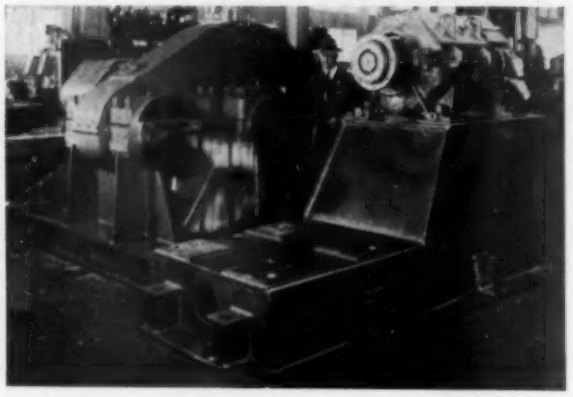


Fig. 1 (Left). Broken end casting on large roll which was replaced by the welded part shown in Fig. 2 (Right).

Lincoln Electric Co. Photo.



Tilting mechanism for 150-ton tilting open-hearth furnace of arc welded construction.

Lincoln Electric Photo

Bent Plates Save Time

This tilting mechanism for a 150-ton tilting open-hearth furnace was fabricated by The Wellman Engineering Company of Cleveland, using arc welded construction practically 100%.

The drive support in the foreground is an excellent example of modern design for welding utilizing bent plates to reduce welding labor. A total of 47 feet 8¾ inches of bending was done on ¾-inch plate in each unit, consisting of the drive support and the gear reduction. The company reports a reduction of 50% in welding time over what would have been required if flat plates had been used.

» «

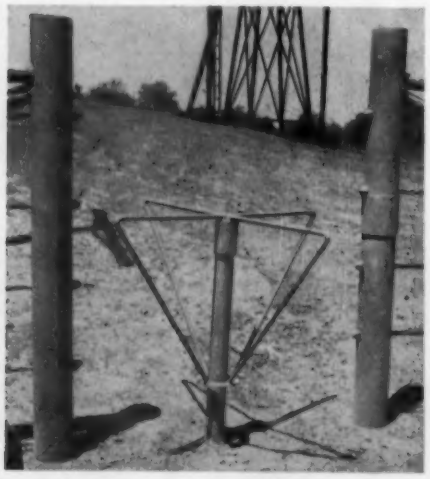
Removable Turnstile

By Elton Sterrett

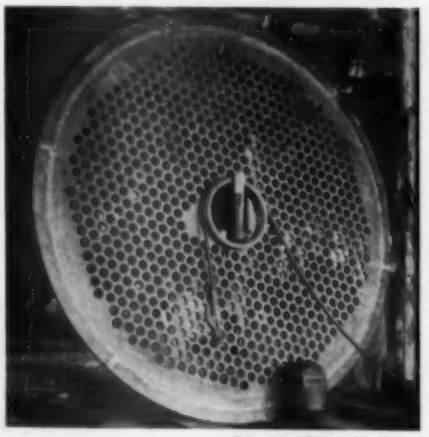
A removable turnstile, readily lifted from its pedestal for handling heavy materials into the plant yard, but effectively blocking the entrance against livestock, was fabricated by the plant welder from scrap materials. A 2½ in. pipe collar serves to carry the arms, of ¾ in. rod, and permits the turnstile to revolve freely over the top of the two inch pipe post. The side arms are bent through an acute angle to join on a ring which rides freely near the base of the post, just above ground level, and thus serve to block the entrance against livestock which might otherwise attempt to shoulder under the usual cross bars.

The opening is effectively locked simply by passing a chain through one of the looped bars and around the fence post, padlocking it fairly tightly. The shape of the arms prevents the chain from dropping or dragging, and holds the bars rigidly across the opening.

» «



A simple yet wholly effective turnstile.



Lincoln Electric Photo

Cast iron plate for evaporating pans increased in diameter by ring arc welded in 6 segments.

Welding Saves $8,000

At Central Josefita, Palos, Cuba, following a procedure worked out in conjunction with considerable experimentation which greatly reduced maintenance costs, by use of arc welding in repair of plates used in evaporating pans for production of sugar, a total of $8,000 was saved over replacement.

These plates are 1 in. thick and 7 ft. diameter. Because excessive heat during welding would result in deformations and stresses caused by expansion and contraction, the electric arc process was employed. It was found that this method avoided excessive heating by limiting the welding area to a smaller zone and the ability to weld slowly.

Tests were made with different electrodes to determine one which would give best possible fusion and a non-porous deposit. The welds were made a bead at a time, peening each one before applying the next. Care was taken to avoid letting the weld cool too much between beads.

Experience obtained on this repair work made it possible to do the job shown in the accompanying illustration. This part is a new cast iron body for making evaporating pans and had been ordered to construct a number of units having large heating surfaces. Since the company wanted to use bronze tube plates from old pans, it was necessary to increase the diameter of the new parts. The method of doing this was to weld a ring to the outside of the plate.

Before the actual welding was done, a test was conducted by welding two steel plates together. The results proved entirely satisfactory, showing high tensile strength and large factor of safety.

The ring welded to the plate was first cut into six segments. Parts were held firmly by bolts and all joints carefully veed. Welding was limited to each section and the work was peened carefully before each subsequent bead was applied. In this way the circumferential weld was completed entirely around the part. Then, the joints at the junction of the segments were welded.

The work described and illustrated here was done by arc welding at a cost of $70, including material and labor. The saving on 12 plates amounted to $8,000.

» «

Fumes Eliminated

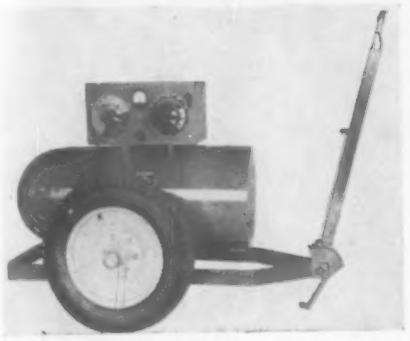
To eliminate any possible hazard from weld fumes in the huge Harnischfeger plant in Milwaukee, a system of fume collectors has been installed. The individual collector units are adjustable to any position and so may be spotted by the welder where they can most effectively draw off the fumes and gases. Because they draw off only a minimum amount of surrounding air, these collectors are economical even for winter use.

This is just one example of the many ways industry is cooperating in an effort to protect the health of the worker. It is a well known fact that the happiest worker is the healthy worker.

Harnischfeger Photo

Safeguarding the welder.

New Product Developments



Easier transportation with a trailer of this type.

Welding Machine Trailer

★ A new two-wheeled light-weight pneumatic-tired trailer for mounting arc welding machines for easy, fast portability in shop, yard or on the road, is announced by **The Lincoln Electric Company,** Cleveland, Ohio.

Designed for mounting either Lincoln SAE 200 to 600 ampere AC motor driven or Type SA 200 special engine driven Lincoln arc welders, the new unit, can be used for road towing up to approximately 30 miles per hour, can be hitched to a factory mule or industrial truck and is easily moved by hand by virtue of the low, underslung construction, narrow 31-inch tread and method of balancing. It is of arc welded steel construction throughout.

Mounting is readily accomplished by means of four bolts in frame of trailer which register with holes in lugs on the welding machine. The combination tow bar and standing support has a hand-operated ratchet arrangement for locking support arm in position. The unit measures 66 inches long, 42 inches wide, and weighs 282 pounds. Tires are 16-inch by 5.50-inch, 4 ply.

» «

Seven ounces is the weight of this welding torch.

Aircraft Welding Torch

★ Exceptional balance for precision work, light weight of only seven ounces for tireless welding, convenient front-end valve wheels for one-hand flame adjustment, compactness to get around jigs and fixtures, and a fast, penetrating flame for sound and uniform welds are claimed for the design of the new **Rego Aircraft Welding Torch** announced by the National Cylinder Gas Co., Chicago, Ill.

Long bend and short bend swaged tips of pure copper, with brass protectors to prevent damage to tip threads, are available in sizes 76, 72, 68, 62, 59, 55, 53 and 51 (drill size of orifice). Flame characteristics may be varied from short to long pointed, as each tip covers a relatively wide range of heat output.

A circular showing the Rego AC in actual size and actual color, exact dimensions of each of the 16 tips, as well as complete operating data (pressures, consumptions, metal thicknesses, etc.) is available and will be sent free upon request.

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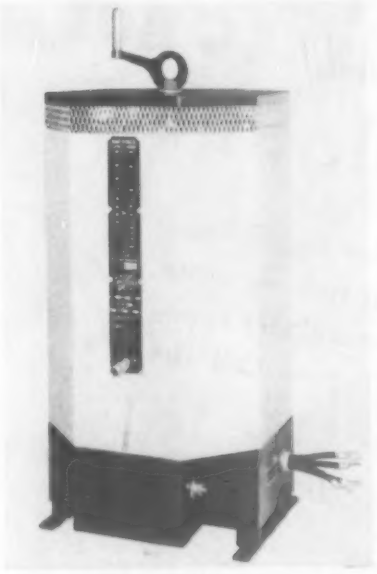


Stepless current regulation is one of the features of this A-C Welder.

Transformer Arc Welders

★ A new line of **A. C. Transformer Welders** in 300, 500, 750 and 1000 ampere capacities has just been announced by **Wilson Welder and Metals Co., Inc.,** 60 East 42nd Street, New York, N.Y.

Known as Model TW, these welders are completely self-contained units suited for use with 220, 440 or 550 volts, 25 or 60 cycle current. When arranged for 220 and 440 volt operation, single phase, either voltage can be brought into use by a reconnection of the leads which are brought outside the unit.

These new welders have a wide range of current output and continuous stepless current regulation is provided over the entire range by means of a hand crank on top of the machine. This crank makes it possible to rapidly shift the setting as changes are made from one class of work to another. They conform to N.E.M.A. requirements; all coil covering is spun glass fibre, heat-resistant, Class BB insulation.

On 60 cycle units, all sizes are fan cooled except the 300 ampere size, which is cooled by natural draft. On 25 cycle units, all sizes are fan cooled. The 60 cycle units have high and low range switches, while the 25 cycle units have only one range. This low range switch provides current adjustments on the 500 ampere size from 40 to 650 amperes. Power factor correction is included in all models for 60 cycle operation except the 300 ampere size. Welders built for 25 cycle operation do not have power factor corrected. Efficiency of all the TW units is approximately 80 to 85%.

Further information or descriptive literature on these new Transformer Arc Welders may be obtained by writing the Wilson Welder and Metals Co., Inc., 60 East 42nd Street, New York, N.Y.

» «

Helmet Slide

★ **Kelley Devices,** Milwaukee, Wis., announce the **Kelley Slide,** a new device designed to offer a comfortable headpiece and a convenient means of removing a welder's helmet shield from the face.

The use of a woven headband it is claimed, makes the wearer more comfortable and its use is made possible by the substitution of a sliding movement for a pivoting action.

The Kelley Slide is simply two spring brass wires bent to conform to the contour of the head, and, two looped wires to embrace these and secured to the shield. The spacing of these yokes enables the wearer to toss the shield up and down easily entirely by head motions. A slight curve in the rails retains the shield in the overhead position until a nod sends it to the working position again. The headpiece is adjustable for size and readily detached for washing.

While light in weight, the entire device is said to be ruggedly constructed for hard service.

» «

Electrode Holder

★ A new **Electrode Holder** has been announced by the **U. S. Electric Welder Corp.,** Toledo, Ohio. The holder while of conventional design features: (1) Alloy metal jaws; (2) better handle ventilation and (3) two ways of connecting the lead cable (a) by soldering or (b) by a set screw.

» «

Spatter Preventative

★ **Thompson and Company,** P.O. Box 6757, Pittsburgh, Pa., announce the release of a new product for the easy removal of weld spatter. Known as Thompson's **"Anti-Spatter"** it is furnished for use on work that is to be pickled as well as non-pickled work. Further information may be obtained from a descriptive folder on Anti-Spatter which the company has issued.

New Product Developments

Welder Control Box

★ Further improvement in Dual Continuous Control for arc welding machines, in the form of a new welder control box of advanced design and construction, is announced by The Lincoln Electric Co., Cleveland, Ohio.

Enhancing the benefits of Dual Continuous Control, the new box, designated **"Type G,"** prevents accidental contact with live parts, increases accessibility, permits wiring with flexible or rigid conduit, or rubber-covered multiple-conductor cable and eliminates dangers from unintentional loosening of the lifting hook.

An important feature claimed for the new box is the fact that there is a separate compartment for all A-C circuits, including push button, and another separate one for D-C terminals.

Another important feature of the "Type G" control box is the improved design and construction of the lifting hook. The new hook eliminates all risk of the hook being unscrewed unintentionally and becoming a hazard.

The control box is permanently grounded to the motor and generator frames through the mounting bolts to take care of special inspection rules which require that both the control box and the frame should be grounded. This feature makes it possible to ground both the control box and the machine by simply grounding the conduit which leads to the box.

An interior view of Lincoln's new control box.

Welding Rods . . . not too plentiful, BUT . . .

if you need stainless electrodes for defense work, alloy and hard surfacing rods or other electrodes for special, out-of-the-ordinary applications, we can probably help you. Call the nearest Ryerson plant.

Electrodes in stock include:

McKay Stainless—7 types

Ryerson Shielded Arc — for Mild Steel and Alloys

Blue Coated — For Cast Iron

Phosphor Bronze—For Brass and Copper

Hard Surfacing Rods

Acetylene Welding Rods

●

Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Cleveland. Detroit, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON

Oversize tires and underslung construction are a feature of this trailer.

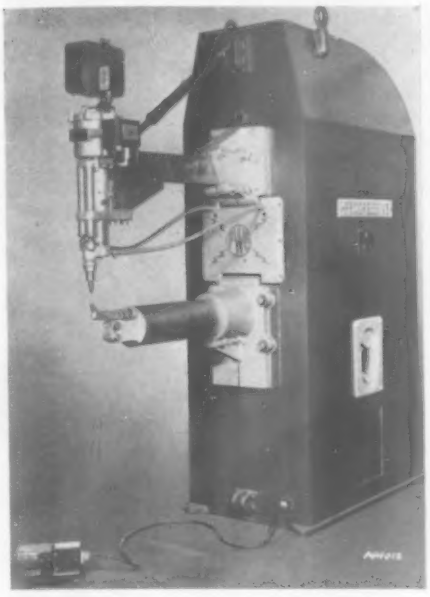
Welding Machine Trailer

★ A new four-wheeled light-weight pneumatic-tired trailer for mounting all Hobart electric drive welders is announced by **Hobart Brothers Co.**, Troy, Ohio. Easy portability makes this new welder doubly useful enabling it to make hurry-up trips to different parts of the plant and yard for emergency production, maintenance and repair work.

The trailer is designed so that the mounting is easily accomplished by means of four bolts in the frame of the trailer which register with four holes in the legs of the welding machine. Unit is easily moved by hand by virtue of the low, underslung construction, narrow 27 inch tread and method of balancing. Trailer is of arc-welded steel construction throughout.

This unit weighs 120 lbs.; measures 12⅞ in. high; 45 in. overall height; 44 in. overall width; 33 in. from hub to hub; 25% tilting angle; 14 in. jumbo 4 ply tires.

New Product Developments



Especially designed for spot welding deep assemblies.

Deep Throat Welder

★ **Progressive Welder Co.**, 3100 E. Outer Drive, Detroit, has introduced a variation of its well-known pedestal welder, a **deep throat welder.**

The deep-throat welder has its lower arm built of heavy tubing and fitted with a replaceable adaptor for the lower electrode. The construction makes unnecessary the supporting of the lower arm by means of the usual braces, due to its inherent rigidity. Elimination of the usual braces, in turn, makes possible sliding deep assemblies over the arm to full throat depth.

The upper arm, carrying the upper electrode and gun assembly, is braced in the conventional manner. Both upper and lower arms are designed so that they may be adjusted in or out to increase or decrease throat depth as may be required.

Features of the deep throat welder include elimination of frequently troublesome flexible shunts; positive hydraulic or air-hydraulic pressure at the electrodes; non-magnetic head construction, cutting induction losses; straight-line movement of the upper electrode; provision of non-flicker pressure switch; positive cooling circulation, etc. The lower arm is adjustable for height as in other Progressive welders.

The welders are available in standard capacities of 75 and 150KV. Other capacities are available on special order.

» «

Pneumatic Die Grinder

★ Powered to perform such heavy, continuous duty work as die grinding at full operating speed and particularly adapted to grinding of fins on airplane engines, the new **THOR 00H Rotary Pneumatic Grinder** is announced by the **Independent Pneumatic Tool Co.**, 600 W. Jackson Blvd., Chicago.

Built for operating small grinding wheels the new THOR 00H Grinder is extended in the reduced diameter of the spindle support to answer requirements of small clearances and to further assist in clearing obstructions. One of the features of the new 00H Grinder is a newly designed roll type throttle which rotates into the closed and open positions.

» «

Welding Positioner

★ A heavy-duty 3,000 lb. capacity **Welding Positioner** was recently announced by the **Industrial Div., Ransome Concrete Machinery Co.**, Dunellen, N. J. The newly designed Positioner has a 40 in. square machined steel table-top provided with 4 radial and 4 longitudinal T-slots to take ¾ in. bolts making for quick and easy set-up of pieces to be welded.

The all-welded construction of the unit it is claimed assures safety to the operator when working under full load conditions. A 3,000 lb. load with a center of gravity 12 in. above table and 12 in. eccentric from center of table may be carried. A tilting motor tilts the table from horizontal to 45 deg. beyond vertical. Table top may be rotated at constant speed or variable speed as desired. Remote push button controls for the convenience of the operator are supplied.

NEW Goggle

for the Welder

This NEW Cool Lightweight Welding Goggle is molded entirely of glossy black, high impact, high strength Durez—exceptionally light in weight. Shallow cups, individually formed for each eye insure perfect fitting and eliminate danger of sparks under the goggle.

Maximum ventilation is provided by staggered slots in the sides and all around the back of the lenses permitting a continuous flow of fresh air but blocking all light rays.

Rubber covered ball chain bridge with adjustable chain anchor and black elastic single adjustment, one piece buckle head band. Weighs less than three ounces complete with lens.

Write Today

on your letterhead for a pair of these No. 420 goggles for test and a copy of our new No. 20 catalog showing our complete line.

SELLSTROM MFG. CO.
626 N. ABERDEEN ST.
CHICAGO ILLINOIS

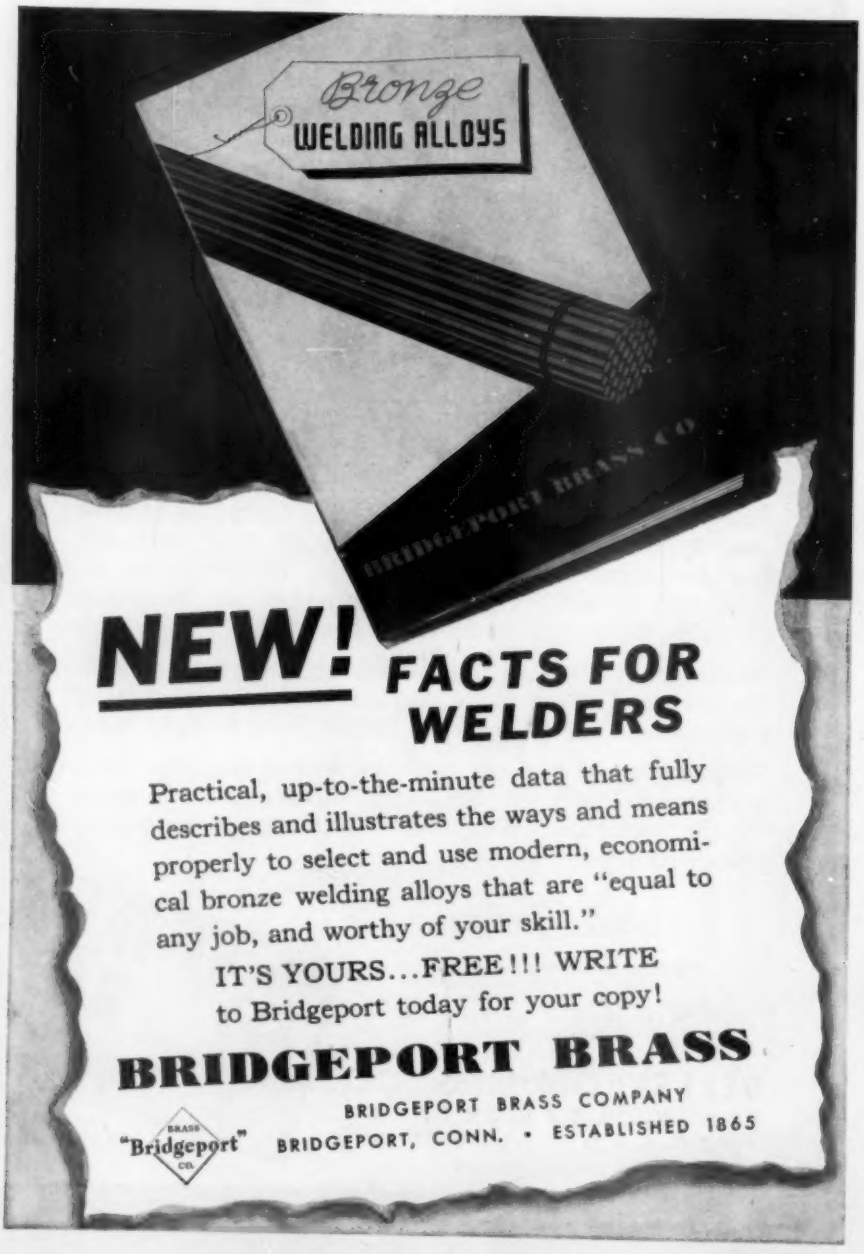
INSIST ON SELLSTROM
. . . THERE IS NO BETTER

News of the Industry

Metal Mining Convention

In these strenuous times and with the keynote, "Metals for Defense" the **8th Annual Metal Mining Convention and Exposition** of the American Mining Congress, Western Division, to be held at San Francisco, September 29-October 2, will have greater significance than ever before.

The advance outline of the program indicates the importance and magnitude of the problems faced today by the mining industry. In addition to the program devoted to economic and operating subjects, there will be a notable display of machinery and supplies, covering all the material and equipment needs of the industry. A series of first-class entertainment features are being arranged to provide amusement and recreation during the evening hours, with special daytime features for the ladies. Inspection trips will be made to some of the many historic and interesting mining fields of California.


Bronze
WELDING ALLOYS
NEW! FACTS FOR WELDERS
Practical, up-to-the-minute data that fully describes and illustrates the ways and means properly to select and use modern, economical bronze welding alloys that are "equal to any job, and worthy of your skill."
IT'S YOURS...FREE!!! WRITE to Bridgeport today for your copy!
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Steel Engineers to Meet

The 1941 Annual Convention of the **American Institute of Steel Construction** will be held at The Greenbrier, White Sulphur Springs, West Virginia, October 14, 15, 16 and 17.

» «

A.W.S. Annual Meeting

The 22nd Annual Meeting of the American Welding Society will be held at the Bellevue-Stratford Hotel, Philadelphia, Oct. 19-24, 1941. A complete program of this meeting will appear in the October *The Welding Engineer*.

Construction

H. C. Price Co. of Bartlesville has been awarded contracts for electric welding of the following pipe lines:

For **Rock Island Refining Co.**—20 Miles of 6-inch near Lebanon, Indiana—General Contractor Sheehan Pipe Line Construction Co.

For **Stanolind Pipe Line Co.**—18 Miles of 8-inch near Dallas City, Illinois—General Contractor Oil States Construction Co.

For **National Refining Co.**—8 Miles of 6-inch near Caney, Kansas—General Contractor F. A. Erard.

For **Illinois Pipe Line Co.**—10 Miles of 12-inch from Albion to Centerville, Illinois and 8 Miles of 10-inch from Flat Rock to Stoy, Illinois—General Contractor Sheehan Pipe Line Construction Co.

For **Gulf Refining Co.**—70 Miles of 10-inch loops in Missouri — General Contractor B & M Construction Co.

For **Plantation Pipe Line Co.**—125 Miles of 12-inch from Baton Rouge, Louisiana to Collins, Mississippi — General Contractor Latex Construction Co.

For **Southern Natural Gas Co.** — 132 Miles of 12-inch, 16-inch and 22-inch loops in Louisiana, Mississippi and Alabama—General Contractor B & M Construction Co.

For **Southern Natural Gas Co.**—Four 10-inch lines across Mississippi River near Lake Providence, Louisiana—General Contractor B & M Construction Co.

For **Consumers Power Co.**—20 Miles of 12-inch near Midland, Michigan—General Contractor Dowding Truck & Transfer.

Trade News

The **Acro Welder Mfg. Co., Inc.**, announce that they have recently moved their offices to new and larger quarters at 1825 W. St. Paul Ave., Milwaukee, Wis.

» «

Hobart Brothers Co., Troy, Ohio announce the appointment of **John L. Foley**, 313 Herman Street, Buffalo, N. Y. as their distributor for arc welders and supplies in the Buffalo territory.

The **Laboratory for Original Welding Research** has been opened in Chicago under the sponsorship of the Sight Feed Generator Company. This laboratory will be in charge of **Carter Clement,** a metallurgist and practical consultant in the welding field.

CARTER CLEMENT

Under the new sponsorship, the Laboratory will not make any charge for consultations or experimental work, under the supervision of Mr. Clement, either in the Laboratory, or in the manufacturer's plant and it reserves the right to compile and pass on, as a national educational welding service, any or all procedures it may see fit, and such findings that tend to improve, simplify or make more profitable the use of A-C electrical welding which is so rapidly proving its many advantages over D-C welding.

Personals

Alexander Jenkins, president and founder of the Alexander Milburn Company, is celebrating his 40th year in the industry. Such a feat makes Mr. Jenkins one of the real old timers in America's fastest growing industry.

ALEXANDER JENKINS

He began his career in England in 1900 when he became interested in the development and manufacture of a calcium carbide projectile for the British Navy. These shells were manufactured in the six inch size with an air chamber sufficient to make them buoyant. They were discharged from a gun and traveled several miles over the surface of the ocean and were self-igniting. At the time of the invention of these shells, the dreaded submarine was a nightmare to Europe's navies and it was the thought of using it against undersea boats that made this shell so popular.

Mr. Jenkins soon realized, however, that it would be more practical to make a peacetime commodity so he devised and began to manufacture an acetylene fog light. A little later he perfected a marine light for use on life buoys and beacons which have now become compulsory for passenger ships.

In 1907 Mr. Jenkins came to America and he established the Alexander Milburn Company to manufacture portable carbide lights. Subsequently the Milburn Company entered the field in manufacturing house lights, generators, large acetylene generators and compressing plants.

Following the close of World War I the Milburn Company began to devote its time to the manufacture of smaller apparatus such as welding equipment, spray guns and similar items requiring precision machining and subsequently discontinued its line of large generating and compressing equipment.

During all these years of progressive manufacturing, Mr. Jenkins has been the guiding hand in the organization and as such has developed, perfected and patented many interesting inventions which

Weld with ALUMINUM BRONZE

Industry's Accepted Alloy for Severe Service

AMPCO-TRODE

THE Only COATED ALUMINUM BRONZE WELDING ROD

HARD . . . . . .
Six practical grades with hardnesses from 100 to 387 Brinell.

STRONG . . . . .
Tensile strength—50,000 to 80,000 p.s.i.—compressive strength, 119,000 to 171,000 p.s.i.

RESISTANT . . .
to wear, fatigue, impact, and corrosion to a remarkable degree.

EASILY USED . .
coated rods, suitable for carbon arc, metallic arc, or oxy-acetylene welding.

When the requirements are severe—when a metal must withstand excessive wear, impact and punishing, industry turns to AMPCO METAL—the metal that makes good when all others fail.

Now, the same remarkable properties of this alloy of the aluminum bronze class are available for welding — in AMPCO-TRODE. There is no other rod like it. Use it for overlaying steel and cast iron — welding copper alloys — building up wear strips, valve seats, large forming and drawing dies — and for a host of other severe service applications. Get complete AMPCO-TRODE literature at once. Write —

AMPCO-TRODE
A product of
AMPCO METAL

AMPCO METAL, INC.
Dept. WR-9
MILWAUKEE, WIS.

are now used in the welding and spraying fields.

» «

In a recent personnel adjustment at South works of **Carnegie-Illinois Steel Corporation, G. S. Mican** was appointed assistant division superintendent of rolling and **D. F. Farnsworth** received the post of superintendent of the No. 1-40" and 35" blooming mills and the 28-32" and 22" structural mills.

George H. Dowding has been appointed superintendent and **Elmer A. Johnson** as assistant superintendent of industrial relations of South works of **Carnegie-Illinois Steel Corp.**

C. B. Voldrich, formerly in the Newport News Office of the Supervisor of Shipbuilding, Navy Dept., as Associate Materials Engineer has now joined the staff of the **Battelle Memorial Institute,** Columbus, Ohio, as welding engineer.

» «

Appointment of **Lincoln R. Scafe,** as general manager of the **Glenn L. Martin-Nebraska Co.,** was announced recently by Glenn L. Martin, president of The Glenn L. Martin Co., the parent concern.

Mr. Scafe, who until recently was general manager of the Fisher Division of General Motors Corp. at Cleveland, will take charge of the new plant now being built at Omaha, Neb., for manufacture of the Martin B-26 bombers. The new company, a wholly-owned Martin subsidiary, recently was awarded a $166,000,000 contract for these airplanes.

The Omaha factory, a duplicate of the Martin Plant 2 at Middle River which also will be devoted entirely to B-26 production, will contain a million and a quarter square feet of floor space. An airport also is being constructed adjacent to the plant.

» «

M. K. McGrath, President, Kellogg Switchboard and Supply Co., Chicago, announced that **F. G. Gardner** of the engineering staff has been selected to fill the position of acting Chief Engineer. **George R. Eaton,** Vice President in charge of Engineering, is taking a leave of absence at the advice of his physician because of ill health.

As a member of the Kellogg staff, Mr. Gardner has been engaged in special transmission engineering work, and his background before coming to Kellogg included extensive experience in both the telephone and telegraph communication fields.

TITAN—the Users' Assurance of Perfect Welding Results.

Trade Mark Registered

TITAN BRONZE WELDING ALLOYS

—preferred by experienced welders from coast to coast — are the result of many years of TITAN pioneering.

DOUBLE DEOXIDATION, developed by TITAN metallurgists, eliminates injurious gases and assures *increased ductility plus greater strength* in the weld deposit.

Our production facilities are being used to their utmost capacity to make available Titan products necessary to the Defense Program. We regret that these requirements are currently in such volume that until this program is completed it will be impossible to fill the requirements of new customers unless they bear a priority rating.

Send for newly-issued folder describing TITAN Alloys. No obligation.

TITAN METAL MANUFACTURING CO.
Bellefonte, Pennsylvania

Obituary

Ernest Wanamaker, inventor of the "Wanamaker Rod" and one-time welding and electrical engineer with the Rock Island Railroad died August 22, at his farm home in Mt. Moriah, Mo.

Current Reviews

Rubber Spring Bulletin

Stripped of highly technical descriptions of the problem of isolating vibration in machines. **The B. F. Goodrich Co.,** Akron, Ohio has just published a new 12 page catalog section on its **Vibro-Insulators,** the devices of metal and rubber which have found wide acceptance in combating the vibration and noise problem.

Excellently illustrated, both with actual installation pictures and engineer's drawings of each type of Vibro-Insulator which it manufactures, the catalog section gives all the pertinent information on each.

The first two pages are filled with a general discussion of the vibration insulation problem and the part that rubber is playing in its solution. Methods of selecting the proper Vibro-Insulator mounting are given, together with methods of mounting, and discussions of uniformity of load distribution, rocking and horizontal motion and the care of the devices.

Applications of the mountings on various types of equipment are listed, together with a table of characteristics. Nine pages are devoted to listing of the

fundamental data for each type of mounting, together with an engineer's drawing of each.

» «

Electrode Data Sheet

Eureka Tool Steel and Alloy Welding Electrodes is the title of a data sheet recently released by the **Welding Equipment and Supply Co.**, Detroit. This data sheet which is approved by the American Society of Tool Engineers lists 13 electrodes of the Welding Equipment and Supply Company. There is also recommendations for the use of these electrodes and data on the properties of the welds produced.

» «

Defense Work

Just Another Job is the Title of a 12 page booklet recently released by the **Link-Belt Co.**, Chicago. As a promotional piece, this bulletin points out the part the Link-Belt Co. is playing in National Defense production. It is stated that about 80 per cent of their production is either directly or indirectly for national defense.

» «

Silver Brazing Bulletin

In a new 16 page Bulletin No. 12 on **Sil-Fos and Easy-Flo** has been issued by **Handy & Harman**, New York.

There are illustrated many examples as to how silver brazing alloys can be used advantageously in making reliable, low cost joints between metals. Other helpful data and application information regarding these alloys is also included.

» «

Tool Grinding Book

Grinding Carbide Tipped Tools is the title of a 64 page spiral bound pocket size book which has just been published by the **Norton Co.**, Worcester, Mass. The book is divided into four sections and discusses: Metal Bonded Diamond wheels; resinoid bonded diamond wheels; green crystalon wheels and there is also a general information section discussing grinding hints and related problems.

» «

Flexible Shaft Machine

A new 8-page brochure describing completely the various flexible shaft machines available for defense industries has been issued by the Walker-Turner Co., Inc., Plainfield, N. J.

Equipment for use in grinding, polishing, burring and for other operations necessary in the manufacture of airplanes, airplane engines and parts, marine engines and accessories, in the automotive field, in general machine shops, foundries and die shops are described in detail.

A copy of this brochure may be had upon request. Ask for Bulletin FS-41. Address Walker-Turner Co., Inc., 604 Berckman Street, Plainfield, N. J.

Ampco Bulletins

Ampco Metal, Inc., Milwaukee, Wis., producers of Ampco Metal, an alloy of the aluminum bronze class, has just issued two bulletins—one entitled **"Ampco Metal in Machine Tools,"** the other **"Ampco Metal in Dies."**

These bulletins are each six pages. Each bulletin is well illustrated with photographs of parts and applications. Each covers specifically the subject matter under discussion.

"Ampco Metal in Dies" tells how Ampco Grades 20, 21, and 22 are largely used in forming and drawing dies. The bulletin points out the qualifications of this alloy of the aluminum bronze class for die service. Reference is also made to the use of Ampco guide pin bushings.

"Ampco Metal in Machine Tools" describes the widespread use of Ampco

READY FOR YOUR JOB...

NEW G-R Model 45H Special Dual

Here's a welder with cost-cutting **flexibility** to meet the wide range required on today's jobs. It provides two lines with current ranges from 40 to 300 amperes each, or a single line with a range of 50 to 580 amperes.

Model 45H is only part of the **complete** G-R line of engineered answers to your present welding problems. Write today for details . . . there's a G-R to fit **your** job, from 20 amperes to 2,000.

GLENN-ROBERTS COMPANY
1009 FRUITVALE AVENUE, OAKLAND, CALIF.
CHICAGO 5651 W. OHIO STREET

The Improved "Round File" Gas Lighter

Most Economical

Unrivalled economy is provided by the many superior, exclusive design and construction features of the Improved "Round File" lighter.

A large file area is provided — approximately one square inch. The file is of superior quality, hardened in our own factory. The spark metal is of large diameter and the patented cartridge holding the metal locks exactly into position, permitting instant replacement. The lighters are cadmium plated, rustproof. Every part thoroughly tested.

Circular and prices on request

SAFETY GAS LIGHTER CO. (Est. 1901) LYNN, MASS.

Metal by the machine tool industry. The bulletin shows why one large manufacturer in the field uses Ampco Metal in 65 applications and another finds the alloy desirable for 54 places in its line of tools. The bulletin also contains a list of typical machine tool applications.

Copies of these bulletins will be sent to interested engineers and metallurgists on request.

» «

Engine Booklet

Power for Industrial Plants, an interesting eight-page booklet produced by **Caterpillar Tractor Co.,** Peoria, Illinois, presents pictorial proof that "Caterpillar" Diesel Engines and Electric Sets are working in many different ways to give the right answer to various power situations.

Installations producing all power needed on full time jobs, serving as an auxiliary to another source of power and acting as standby units are portrayed.

To receive this booklet ask for Form 6904.

» «

Welding Control Panel Folder

Welding circuit control panels with basic ratings up to 300 amperes for constant potential multiple operator welding systems are described in a new 4-page folder announced by Westinghouse Electric and Manufacturing Co.

Enclosure types and general panel construction are described. Explanations of panel current rating and circuit controls are given with a note on resistor units used. Special combination panels for carbon and metallic arc welding are discussed.

A copy of **catalog section 26-210** may be secured from department 7-N-20, **Westinghouse Electric and Manufacturing Co.,** East Pittsburgh, Pa.

» «

Contour Sawing Handbook

Of particular interest to DOALL operators, vocational teachers, N.Y.A. officials and trainees, is the **New Contour Sawing Handbook** published by **Continental Machines, Inc.,** Minneapolis, Minn.

The Handbook contains 158 pages devoted to illustrations and guide charts covering all phases of contour sawing and filing of metals to any desired shape. Contour sawing in comparison with other machining processes such as the shaper, nibbler, lathe, miller, and torch cutting is made in the first section of the Handbook. Section two illustrates application and work accomplished by contour sawing. Section three gives a short resume of machine tools and their direct effect on our standard of living.

The Handbook is free. All requests should be directed to Continental Machines, Inc., Minneapolis, Minnesota.

» «

Clamp Catalog

Knu-Vise toggle action clamping fixtures is the subject of a 24-page catalog just released by **Knu-Vise, Inc.,** 16841 Hamilton Ave., Detroit.

It features 22 different models of clamps, pliers, plier-parallels, "C" clamps, riveters and drill fixtures.

» «

The Defense Program

The next six months will probably see the turning point in the defense program as it affects the average citizen and his pocketbook. For the past year Americans have had both "guns" and "butter." We are now facing a period of necessary sacrifices, and we must choose the nature of those sacrifices.

These are the conclusions of **Guns, Planes, and Your Pocketbook,** by Rolf Nugent of the Russell Sage Foundation, published today by the Public Affairs Committee, Inc.

Guns, Planes, and Your Pocketbook, is the fifty-ninth in a series of popular, ten-cent pamphlets on current economic and social problems published by the **Public Affairs Committee, Inc.,** 30 Rockefeller Plaza, New York City. Other Public Affairs Pamphlets relating to defense are: If War Comes—Mobilizing Machines and Men, How Shall we Pay for Defense, and Defense and the Consumer.

MEETING DEFENSE NEEDS WITH
faster, more economical
WELDING PRODUCTION

Here is the bottom carriage of a 155 MM field gun, mounted on a three-ton capacity C-F Positioner, being "down-hand" welded on top, bottom and sides with just one set-up. The Positioner tilts the assembly 135°, swings it in a full circle and table may be raised and lowered to any desired height for maneouvering large work.

★ If you have assemblies of this awkward size and shape; hard to handle and expensive to weld *right,* you need a C-F Positioner. These production machines are saving time and money in many industries. Write today for our Circular W.P. 20 which describes C-F Positioners from ½ to 7 ton capacities.

CULLEN-FRIESTEDT CO.,
1309 S. KILBOURN AVE. CHICAGO, ILLINOIS

Die-Welding Catalog

The **Welding Equipment and Supply Co.**, Detroit, Mich., has published a 20 page catalog on **Eureka Tool Steel Welding Wires.** There is given a complete description of the eight Eureka welding wires used for tool steel welding as well as method of application and other pertinent data of interest in the fabrication and rebuilding of tool steel dies.

» «

Electrode Catalog

In a new 24 page catalog **"Mallory Resistance Welding Electrodes and Alloys"** **P. R. Mallory & Co., Inc.,** Indianapolis, Ind., describe and picture their line of stock resistance welding electrodes. There is also included specifications, dimensions and pointers on how to set up electrodes for various welding applications.

The booklet is completed with alloy recommendations and the physical and electrical properties of the various Mallory alloys.

» «

Less Priority Metal

"How to Get Along With Less Priority Metal" is the timely and vitally important theme adopted by **Metallizing Engineering Co., Inc.,** Long Island City, N. Y., in the most recent issue of Metco News. This 16-page book shows how it can be done with the metal spraying process — especially in the production and maintenance of rotating and reciprocating mechanisms. Many actual instances of unusual savings, not only in metal but in time and money as well, are described in detail and illustrated with photographs and diagrams.

» «

Ampco Catalog

Ampco Metal, Inc., Milwaukee, Wis., producers of bronze alloys have just issued **Catalog 22** describing Ampco Metal, an alloy of the aluminum bronze class. This new 24 page book is well illustrated with photomicrographs, parts, and factory views. It contains descriptions of the alloys and a comprehensive table of physicial properties and range of chemical composition.

Each of the six grades of Ampco Metal is described in detail in the new catalog, and included are illustrations of castings made from the particular grade under discussion. These depict the wide range of parts that are made from this alloy.

The use of Ampco in bushings, gears, acid-resistance service, and dies is discussed, while other topics include centrifugal casting, welding rod, forging, and machining. One table covers the uses of Ampco Metal by grades.

Engineers and metallurgists who are interested in aluminum bronze are invited to write for copies of Ampco Metal Catalog 22.

» «

Welding System Booklet

A constant potential d-c welding system for supplying welding energy to multiple arc circuits is described in a new eight-page booklet announced by **Westinghouse Electric and Manufacturing Co.**

Motor-generators with ratings from 750 to 1500 amperes to meet welding system requirements are discussed with a note on parallel operation. Mechanical parts, controls, and motor starting equipment are described. A typical wiring diagram shows electrical arrangement of principle parts in the system.

Distinctive features and prices are listed for the stationary and semi-portable units and accessories.

A copy of **catalog section 26-200** may be secured from department 7-N-20, Westinghouse Electric and Manufacturing Co., E. Pittsburgh, Pa.

» «

Conserving In Essential Industries

When industry is confronted with emergency production demands, the need for more effective accident controls in order to conserve men, money, and materials becomes of paramount importance. Plant expansion, development of new processes, maintenance of heavily worked equipment, employment of new workers, and other similar problems call for more than usual ingenuity and skill on the part of management, if a "job" is to be done not only well but safely.

IN 1936—SOMEBODY SAID

"Scrap it!"

Oxy-acetylene welding with 10 lbs. of Tobin Bronze rod saved this 300 lb. casting from the junk pile. Repair-welded by Gemme Garage, St. Damase, Quebec.

But it was repair-welded with Tobin Bronze. Still going strong in December 1940!

When cracks appeared in the base of this crude-oil engine block, attempts to prevent their extension by clamps proved futile. In a short time they had practically encircled the cylinder — only fifteen inches of solid metal remaining between the ends of the cracks.

Replacement meant heavy cost and important time lost waiting for the new casting. It was then that Tobin Bronze welding was suggested. And just ten hours later, the engine base was ready to go back into service.

Every day similar cases demonstrate that expensive equipment, seemingly damaged beyond repair, can often be salvaged at nominal cost by welding with Tobin Bronze—a time-tried Anaconda product. The trademark "Tobin Bronze Reg. U. S. Pat. Off." is stamped in every rod. Look for it and be sure you get the genuine. 41180

ANACONDA

Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Co.

TEAR CORAL ROCK TO PIECES!

These dredge cutter blades, now being rebuilt with P&H Harcote, are delivering three and four times more work hours than formerly on this highly abrasive application in Florida. This is due to the superior hardness and strength of this outstanding electrode. (Full information on request.)

HARCOTE

Its semi-austenitic weld metal has a hardness of approximately 50, Rockwell C, in its as-welded state and builds up great resistance to abrasion under cold working. May be applied to carbon steel, low alloy, and high manganese surfaces.

P&H Harcote is highly recommended for the hard surfacing of many products subject to severe abrasion such as shovel teeth, scraper blades, farm implements, lips and bottoms of shovel buckets, sand and rock handling equipment, etc. An all-position electrode. Ask for simple procedures.

P&H WELDING ELECTRODES

General Offices: 4513 West National Avenue, Milwaukee, Wisconsin

HARNISCHFEGER CORPORATION

WELDING ELECTRODES • MOTORS • HOISTS P&H ELECTRIC CRANES • ARC WELDERS • EXCAVATORS

These vital considerations are emphasized in a new report issued by the Industrial Safety Section of the Metropolitan Life Insurance Co. The report is entitled, **"Conserving Men, Money, and Materials in Essential Industries."** It is basically a discussion check list for the industrial executive concerned with emergency production.

The report lays particular stress on the proper consideration of accident costs. Of far greater significance than the threat of personal-injury accidents are the enormous potential losses of precious time and the spoilage of equally precious materials that result from mishaps sometimes termed "near accidents"—indirect losses which are generally overlooked in compiling accident reports or statistics, yet which to the production executive represent very real items of industrial waste.

As an aid to the study of industrial accidents and to point up proper means for their control, the report briefly develops several fundamental considerations for employee safety.

Copies of this report are available to executives who address the Bureau on their business stationery. Address: Policyholders Service Bureau, **Metropolitan Life Insurance Co.**, One Madison Ave., New York.

Recent Patents

Safe Welding

2,249,457. **James T. Catlett,** Scotia, N. Y., and **Jasper E. Anderson,** Saugus, Mass., assigned to **General Electric Co.,** of New York. An arc welding system is described in which normal arc welding current and voltage are conveniently available for welding without imposing unnecessary hazards on the welding operator due to prolonged open circuit or short circuit conditions in the welding circuit. In the system normal current and voltage are available for a predetermined time before welding, during welding, and after the welding operation has been interrupted. The system includes a source of supply, an arc welding circuit, and means responsive to the operation of maximum and minimum voltage relays connected to be responsive to the voltage of the circuit for controlling the connection of the circuit with the source of supply.

» «

Armor Welding

2,249,629. **Robert K. Hopkins,** West New Brighton, Staten Island, N. Y., assigned to **M. W. Kellogg Co.,** New York, N. Y. Filed April 11, 1939. Issued July 15, 1941. Welded armor plate for vehicles, shields, turrets, ships, and the like is shown. The armor includes a plurality of superimposed zones or layers united into the integral structure by fusion. One of the layers, which is the hard

(Continued on page 51)

Conversion Factors for Engineers

The word gallon, used in any conversion factor, designates the U. S. gallon. Likewise, the word ton designates a short ton, 2,000 pounds.

The figures 10^{-1}, 10^{-2}, 10^{-3}, etc., denote 0.1, 0.01, 0.001, etc., respectively.

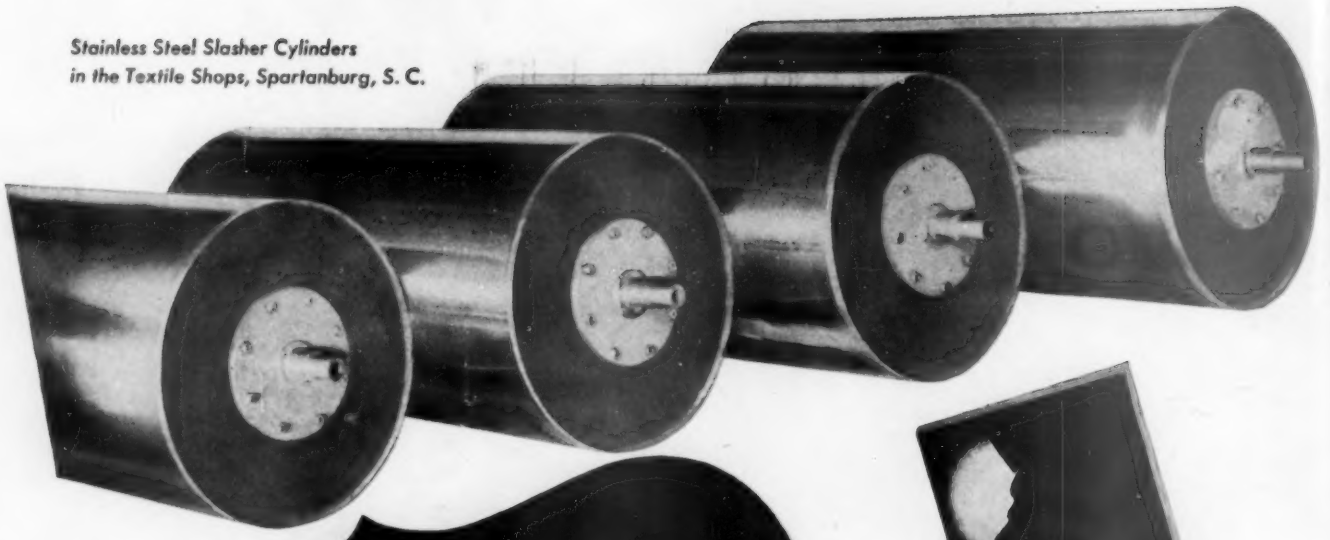
The figures 10^{1}, 10^{2}, 10^{3}, etc., denote 10, 100, 1000, etc., respectively.

"Parts Per Million," (designated as p.p.m.), is always by weight. As used in the sanitary field, p.p.m. represents the number of pounds of dry solids contained in one million pounds of water. In this field, one part per million may be expressed as 8.345 pounds of dry solids to one million U S. gallons of water.

Multiply	By	To Obtain
Acres	43,560	Square feet
"	4047	Square meters
Acre-feet	43,560	Cubic feet
" "	325,851	Gallons
" "	1233.49	Cubic meters
Atmospheres	29.92	Inches of mercury
"	33.90	Feet of water
"	76.0	Cms. of mercury
"	14.70	Lbs./sq inch
Barrels cement	376	Pounds—cement
Bags or sacks-cement	94	Pounds— "
British Thermal Units	777.5	Foot-lbs
" " "	3.927×10^{-4}	Horse-power-hrs.
" " "	2.928×10^{-4}	Kilowatt-hrs.
" " "	0.2520	Kilogram-calories
" " "	107.5	Kilogram-meters
B.T.U./min.	12.96	Foot-lbs./sec.
" "	0.02356	Horse-power
" "	0.01757	Kilowatts
Centimeters	0.3937	Inches
Centimeters of mercury	0.01316	Atmospheres
" " "	0.4461	Feet of water
" " "	27.85	Lbs./sq. ft.
" " "	0.1934	Lbs./sq. inch
Centimeters/second	1.969	Feet/min.
" "	0.03281	Feet/sec.
" "	0.6	Meters/min.
Cubic centimeters	3.531×10^{-5}	Cubic feet
" "	6.102×10^{-2}	Cubic inches
" "	2.642×10^{-4}	Gallons
" "	10^{-6}	Cubic meters
" "	10^{-3}	Liters
Cubic feet	7.48052	Gallons
" "	1728	Cubic inches
" "	0.03704	Cubic yards
" "	28.32	Liters
" "	2.832×10^{4}	Cubic cms.
" "	0.02832	Cubic meters
Cubic feet/second	0.646317	Million gals./day
" " "	448.831	Gallons/min.
Cubic inches	16.39	Cubic centimeters
" "	5.787×10^{-4}	Cubic feet
" "	1.639×10^{-5}	Cubic meters
" "	4.329×10^{-3}	Gallons
" "	1.639×10^{-2}	Liters
Cubic meters	35.31	Cubic feet
" "	1.308	Cubic yards
" "	264.2	Gallons
" "	10^{3}	Liters
Cubic yards	27	Cubic feet
" "	46.656	Cubic inches
" "	0.7646	Cubic meters
" "	202.0	Gallons
" "	764.6	Liters
Drams	27.34375	Grains
"	0.0625	Ounces
"	1.771845	Grams
Fathoms	6	Feet
Feet	30.48	Centimeters
"	0.3048	Meters
Feet of water	0.8826	Inches of mercury
" " "	0.4335	Lbs./sq. inch
" " "	62.43	Lbs./sq. ft.
" " "	0.02950	Atmospheres
" " "	304.8	Kgs./sq. meter
Feet/sec.	30.48	Centimeters/sec.
" "	18.29	Meters/min.
Foot-pounds	1.286×10^{-3}	British thermal units
" "	5.050×10^{-7}	Horse-power-hrs.
" "	0.1383	Kilogram-meters
" "	3.766×10^{-7}	Kilowatt-hrs.
Foot-pounds/min.	3.030×10^{-5}	Horse-power
" " "	2.260×10^{-5}	Kilowatts
Gallons	0.1337	Cubic feet
"	231	Cubic inches
"	3785	Cubic centimeters
"	3.785×10^{-3}	Cubic meters
"	3.785	Liters
Gallons, Imperial	1.200095	U. S. gallons
" U. S.	0.83267	Imperial gallons
Gallons water	8.3453	Pounds of water
Gallons/min.	2.228×10^{-3}	Cubic feet/sec.
" "	0.06308	Liters/sec.
" "	8.0208	Cu. ft./hr.
Grains (troy)	1	Grains (avoir.)
"	0.06480	Grams
Grains/U.S. gal.	17.118	Parts/million
" /U.S. gal.	142.86	Lbs./million gal.
" /Imp. gal.	14.254	Parts/million
Grams	15.43	Grains
"	0.03527	Ounces
"	980.7	Dynes
Grams/liter	58.417	Grains/gal.
" "	8.345	Pounds/1000 gals.
" "	1000	Parts/million
Hectares	2.471	Acres
Horse-power	42.44	B.T. Units/min.
" "	550	Foot-lbs./sec.
" "	0.7457	Kilowatts
Horse-power (boiler)	33,479	B.T.U./hr.
" " "	9.803	Kilowatts
Inches	2.540	Centimeters
Inches of mercury	1.133	Feet of water
" " "	0.4912	Lbs./sq. inch
" " "	0.03342	Atmospheres
" " "	345.3	Kgs./sq. meter
Inches of water	0.07355	Inches of mercury
" " "	0.03613	Lbs./sq. inch
Kilograms	2.205	Lbs.
Kilograms-calories/min.	51.43	Foot-pounds/sec.
" " "	0.09351	Horse-power
" " "	0.06972	Kilowatts
Kgs./sq. meter	3.281×10^{-3}	Feet of water
" " "	1.422×10^{-3}	Lbs./sq. inch
Kilometers	3281	Feet
"	0.6214	Miles
Kilometers/hr.	0.9113	Feet/sec.
" "	27.78	Centimeters/sec.
Kilowatts	56.92	B.T. Units/min.
"	737.6	Foot-lbs./sec.
"	1.341	Horse-power
"	14.34	Kg.-calories/min.
Liters	0.2642	Gallons
"	61.02	Cubic inches
"	0.03531	Cubic feet
Meters	3.281	Feet
"	39.37	Inches
"	1.094	Yards
Miles	5280	Feet
"	1.609	Kilometers
Miles/min.	88	Feet/sec.
" "	1.609	Kilometers/min.
Milligrams/liter	1	Parts/million
Million gals./day	1.54723	Cubic ft./sec.
Miner's inches	1.5	Cubic ft./min.
Ounces	28.349527	Grams
"	437.5	Grains
"	0.9115	Ounces (troy)
Ounces (fluid)	1.805	Cubic inches
" "	29.57	Cubic cm.
Parts/million	8.345	Lbs./million gal.
" "	0.0584	Grains/U. S. gal.
" "	0.07016	Grains/Imp. gal.
Pounds	16	Ounces
"	7000	Grains
"	453.5924	Grams
"	1.21528	Pounds (troy)

*Selections from a booklet of—"Conversion Factors for Engineers"—distributed by The Dorr Co., New York City.

Stainless Steel Slasher Cylinders in the Textile Shops, Spartanburg, S. C.



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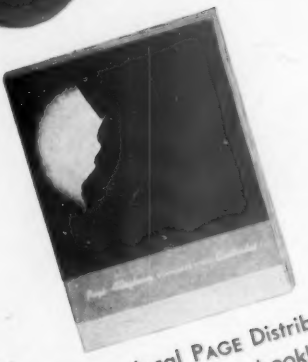

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Recent Patents

(Continued from page 49)

outer layer, is an alloy steel containing from 3% to 20% chromium, molybdenum in effective amounts not exceeding 3%, carbon in effective amounts not exceeding 1.5% and the remainder substantially all iron. The other, or backing layer, is an alloy steel containing about 4.0% nickel, about 1.5% chromium, about 0.15% carbon and the remainder sustantially all iron. The outer layer has a hardness of 550 Brinell; while the backing layer has a hardness of 275 Brinell.

» «

Welding Noncorrosive Metal

2,249,723. **John B. Orr, Jr.,** Sewickley, Pa. Filed May 16, 1938. Issued July 15, 1941. For welding stainless steel, or clad stainless metal members, without causing a loss of the corrosion-resisting properties, suitable temperature control is employed during a hot welding operation. Noncorrosive weld metal is used to join the outer clad layer ends, the metal being applied to the juncture portions in a finely divided state under pressure and in a molten state by a non-oxidizing gaseous agency. The noncorrosive portion of the weld is acid-treated with nitric, sulphuric, or a mixture of these acids to remove surface dullness, to avoid buffing. The noncorrosive sides to be welded may be roughened prior to the welding operation. The acid treatment increases the corrosion-resisting properties.

» «

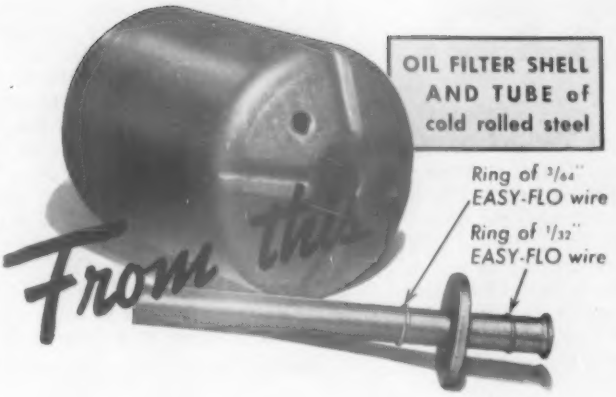
Rubber Coated Rod

2,249,017. **Arthur R. Lytle,** Niagara Falls, N. Y., and **Thomas H. Vaughn,** Trenton, Mich., assigned to **Oxweld Acetylene Co.,** of West Virginia. Filed Jan. 20, 1940. Issued July 15, 1941. This patent describes a welding rod comprising a metal core and an adherent coating, such coating comprising a solid weld modifying substance and a thermoplastic rubber hydrochloride. The rubber material may be Pliofilm. When the rod is used for welding substantially no charred residue or disagreeable fumes are produced.

» «

Blowpipe

2,249,338. **Lloyd W. Young,** Scotch Plains, N. J., assigned to **Oxweld Acetylene Co.,** of West Virginia. Filed Dec. 31, 1937 Issued July 15, 1941. A blowpipe mixer element of exceptionally high flashback resistance, yet of simple and light construction, can be made, according to this patent, by using a new type of mixer block. The pipe includes a mixer block having a plane forward end through which passes a substantial axial gas passage for acetylene and another passage for oxygen. One of the passages terminates in the plane forward end of the block. The block also has an annular groove in its forward end in which the other passage terminates. A mixture conduit having a plane rear end is positioned with that end spaced slightly apart from the forward end of the mixer block.



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The acetylene and oxygen traverse the passages and contact at right angle flow prior to emergence from the blowpipe tip, thereby providing high flashback resistance.

» «

Rod Coating Method

2,249,085. **Karl Lange,** Berlin, Germany. Filed Dec. 8, 1937. Issued July 15, 1941. The invention of this patent is concerned with a process for making electrodes with pressed-on coatings, according to which the coating substance is pressed on the rod by means of a nozzle system. The process is automatic. The rods, arranged one before another, periodically are moved forward, by one rod length, from a rod magazine by making use of a feeding device. During the interruption of the motion the contact end of the rod is freed from the coating and the rods, extruding from the coating nozzle, are conveyed separately and taken from the conveyor and deposited on a coordinated drying band by means of a mechanical device operating synchronously with the feeding device. A knife or other cutting device, or a jet of compressed air is used to free the ends of the rods of the coating. Coating of the ends can be avoided entirely, if desired, by the use of an expansible membrane in the coating nozzle. Operated by hydraulic pressure, the membrane is contracted, thereby decreasing the pressure on the nozzle for applying the coating. During this slight interruption, the rod passes through the nozzle for a short distance without being covered. By expanding the membrane, the pressure becomes great enough to coat the remainder of the rod.

» «

Welding Hood

2,249,239. **George W. Goldsmith,** Comptom, Calif. Filed Nov. 22, 1938. Issued July 15, 1941. A welder's helmet comprising a crown adapted to fit the top of the head, a panel attached to the front and sides of the crown, the ends of the panel extending to the rear of the helmet and overlapping to close the rear, and a light port in the front of the panel fitted with a lens, is shown. Straps attached to opposite sides of the lens pass through keepers on opposite sides of the helmet to the rear of the helmet. An adjustable fastener is attached to the ends of the straps at the rear of the helmet. An air port is located in the front of the helmet beneath the light port, the air port having a seam along its sides to permit free influx and efflux of air to the nose without permitting exhaled air to contact the inner surface of the lens. The body of the helmet is made from pliable fabric or leather. The wearer of such a helmet may lie flat on his back or on his side or stomach, or in any other position without causing the hood to be shifted from its normal position or without the necessity of holding it in place while in these abnormal positions. The construction is such as to avoid fogged lenses due to condensed moisture. Indirect reflected light, known as "back light" is also avoided.

» «

Welding Tip

2,249,361. **Harry V. Inskeep,** Fanwood, N. J., assigned to **Oxweld Acetylene Co.,** of West Virginia. Filed Sept. 14, 1939. Issued July 15, 1941. For gas welding circumferentially thick-walled pipe, such as oil well drill pipe, a multi-frame welding tip is employed. The invention is based upon the discovery that, by using two widely spaced flanking flames, one on each side of and about three-fourths of an inch from the center of the V, and in the same general plane as three principal welding flames of the tip, the time required for preheating is considerably reduced, and the welding speed is substantially increased. The jets are so disposed and directed as to dam the heat at the welding zone, and thus lessen the heat flow from the molten puddle to the cooler base metal. They also act to form a hot gaseous envelope over the molten puddle, thus keeping the metal molten longer, and permitting foreign inclusions to rise to the surface of the puddle. Their use also permits the use of a large size welding rod, and eliminates the need for lateral movement of the tip transversely of the weld seam during the operation.

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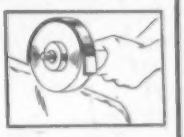

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Electrode Holder

2,244,286. **Oscar L. Callahan,** West Frankfort, Ill. Filed Sept. 2, 1939. Issued June 3, 1941. The object of this invention is to provide an implement comprising an electric conductor to which a cable can be attached and which is secured in an operating handle at one end, while its other end carries gripping members that can be opened and closed by a relative rotary motion between the gripping members and the conductor. The holder ejects a consumed rod and permits simple introduction of a new rod.

» «

Circuit Control

2,249,869. **Colby W. Steward,** West Springfield, Mass., assigned to **Westinghouse Electric & Mfg. Co.,** Pittsburgh, Pa. Filed Jan. 4, 1939. Issued July 22, 1941. The object of this invention is to control automatically the sequence of the application of the electrode pressure and the energization of the welding circuit in fluid pressure actuated seam or spot welding apparatus, so as to prevent energization of the welding circuit unless a predetermined differential of fluid pressure exisits between particular points in the fluid pressure system.

» «

Spot Welder Tip

2,249,937. **K. F. Bohn,** Lockport, N. Y., assigned to **General Motors Corp.,** Detroit, Mich. Filed Sept. 30, 1940. Issued July 22, 1941. The inventor provides a simple and inexpensive tip structure arranged to be mounted securely but replaceably on the free end of a projecting holder, the interconnection keying the parts against dislodgement but enabling quick interchangeability. The holder has circulating passages for the flow of cooling fluid to immediately adjacent the tip seat. The tip is held in a hairpin shaped retainer having its bight fitted within a peripheral recess in the tip and its side legs fitted within axially extending recesses in the supporting rod.

» «

Arc Welder Head

2,250,219. **Verni J. Chapman,** Schenectady, N. Y., assigned to **General Electric Co.,** of New York. Filed Nov 29, 1940. Issued July 22, 1941. When heavy coated electrodes are supplied from a continuous coil to an automatic arc welded head, it has been found that when the electrode is made of soft material, it receives as the result of its coiling a permanent set which interferes with the proper operation of the welding head when it is swung from one position to another. The invention includes a support and cross-feed adjustment by means of which the welding head may be swung from one position to another, held in a desired position and adjusted a slight amount from this position by a cross-feed adjustment. The welding head is hinged about a non-rotatable pin. A lever releasably clamped to the pin and attached to the welding head is used to hold the head in any desired position to which it may be swung about the pin. The spacing of the lever and the head relatively to one another is also adjustable.

» «

Multilayer Welding

2,250,617. **Lucien F. Argentin,** Philadelphia, Pa., assigned to **Budd Mfg. Co.,** Philadelphia, Pa. Filed Sept 3, 1938. Issued July 29, 1941. A plurality of superimposed thin layers are welded by adding an additional layer of material having characteristics similar to that of the thin layers with regard to melting temperature on each side of the layers, and passing a welding current through all the layers sufficient to fuse a single nugget from all the layers but not completely through the additional outer layers. The outer layers are left readily removable and non-adhering, and these layers are removed. The process is suitable for welding sheets of stainless steel in many layers to obtain a weld nugget or fused portion which extends through all the layers.

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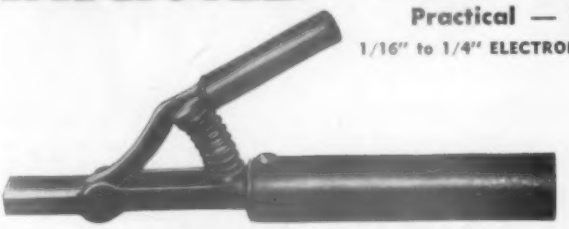

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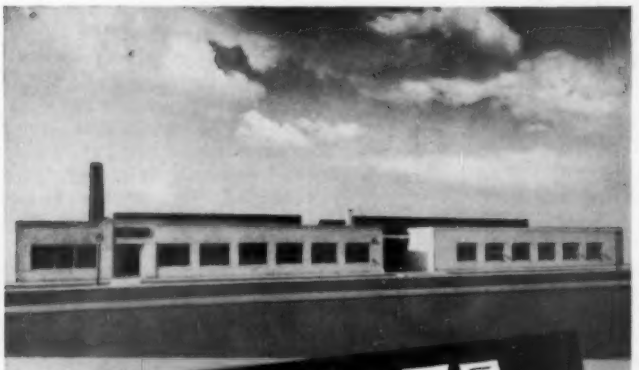

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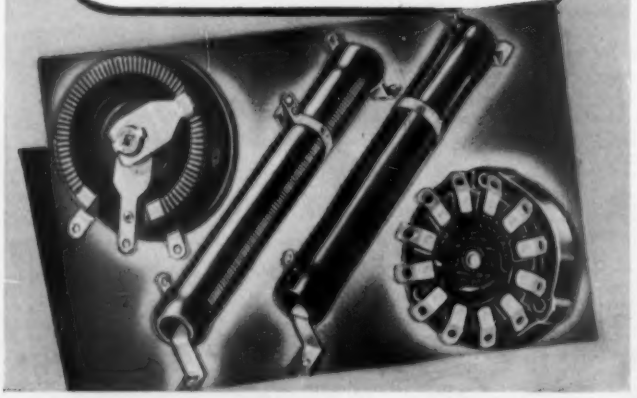

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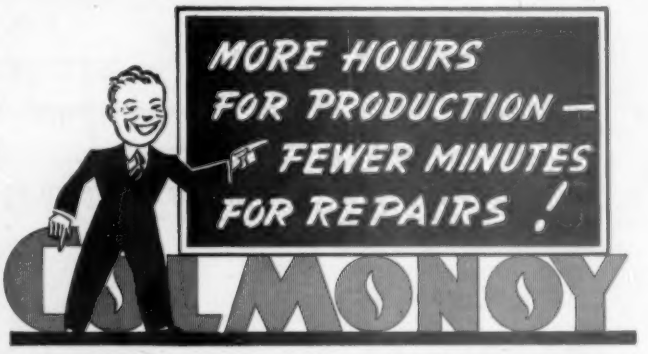

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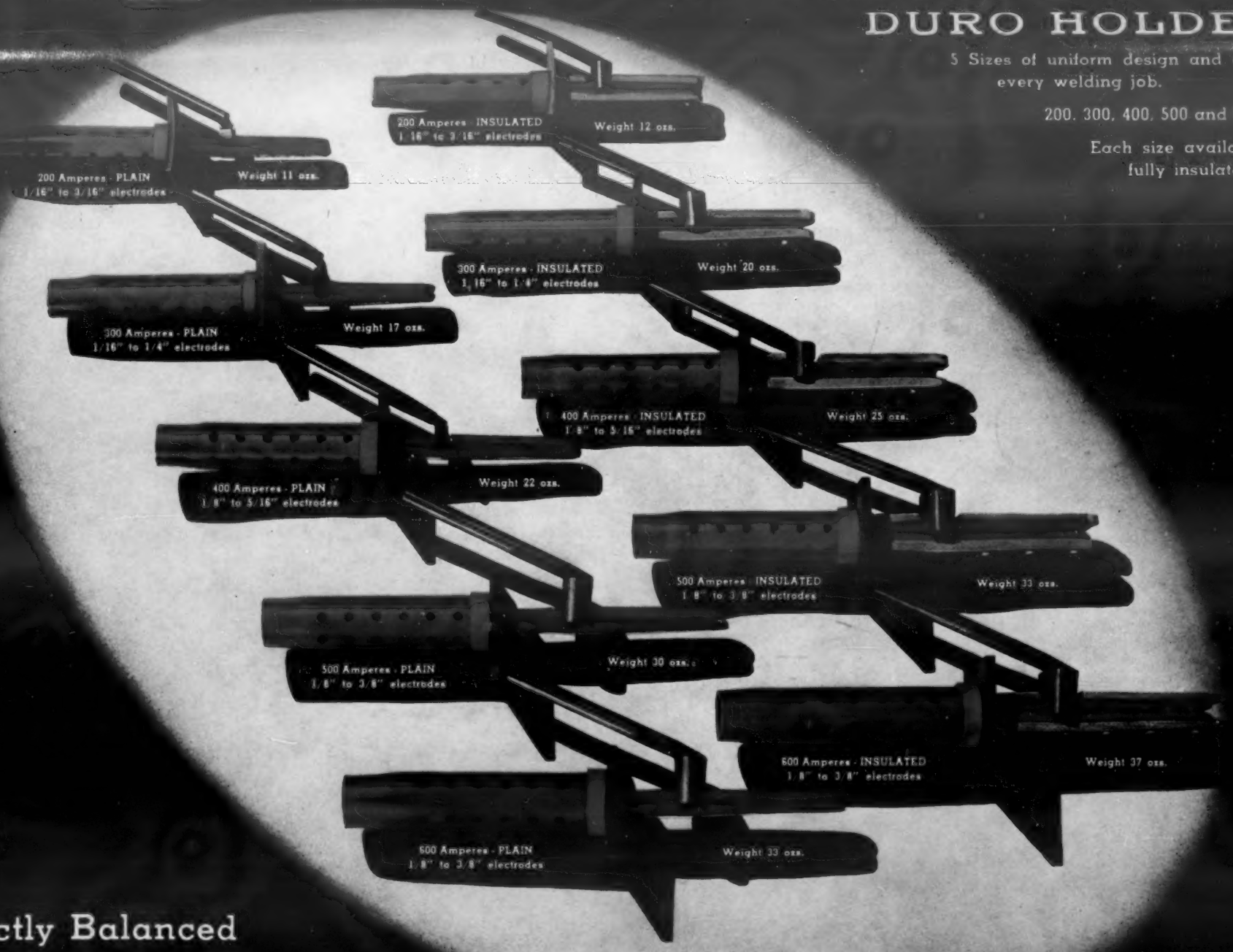

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